Compressed Air Magazine

Vol. 43, No. 11 London - New York - Paris November, 1938

CHAT PILE OF A ZINC-LEAD MILL

OPERATES COMPRESSORS TO CAPACITY AT FAR LESS COST

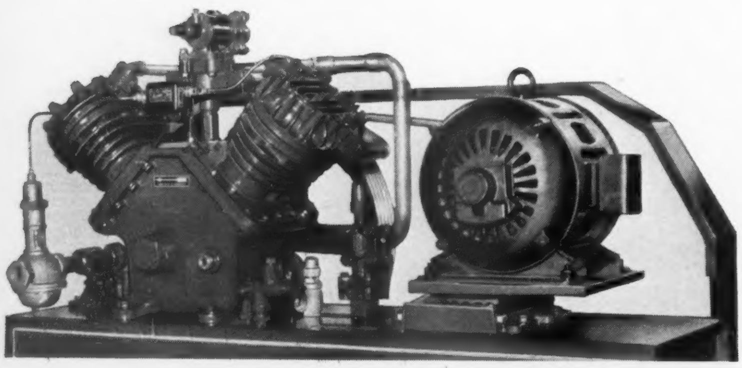
IMPROVES COMPRESSOR PERFORMANCE --SAVES POWER --OFTEN DOUBLES BELT LIFE

At the right is a view of a Rockwood Drive on a 200 h.p. G.E. motor driving a Sturtevant blower in the plant of the Doernbecker Mfg. Company, one of the world's largest manufacturers of furniture, in Portland, Oregon. The blower is kept up to speed, its operation is more dependable and less costly. Rockwood Drives are now transmitting close to one million horsepower—most of which is made up of installations on hard drives such as this one.

Any desired part of the motor weight—lightly cradled in the belt—is used to automatically maintain just the right amount of belt tension necessary to insure uniform driven speeds and give best possible machine performance.

With the Rockwood pivoted-motor base gravity weight—plus the "kick-back" or re-action torque of the motor causes the belt tightness to increase or decrease as the load increases or decreases. This occurs automatically so the belt always operates at lowest tension required to handle the changing loads without excessive belt slip.

ROCKWOOD PIVOTED MOTOR DRIVE



With small compressors the Rockwood base is a "must have." More air for less cost—more dependable performance—the V-belt replacement cost often cut in half. The cost of a Rockwood base for a small compressor is almost negligible compared to the improvement in operation it brings.

Put Rockwood Drives on *your* compressors

With a Rockwood Drive on your compressor you can do either the same work for less or have your compressor do more work for the same cost. No matter whether you use V-belts or flat belts you need a Rockwood Drive. Both types of belts stretch and the automatic action of the Rockwood Base keeps driven machines up to speed and eliminates belt slip and wear.

Write for recommendation for a Rockwood Drive for your compressor. It will pay for itself quickly. No belt driven compressor can do its best work or operate as economically unless it has a Rockwood pivoted-motor Drive. **Let us hear from you.**

Rockwood Manufacturing Company—*Indianapolis, Indiana*

ON THE COVER

THIS view is typical of the Tri-State zinc and lead district, where great heaps of chats, or waste rock, mark the locations of concentrating mills. The material, consisting of stone fragments half an inch or less across, is elevated from the mill, conveyed by water through flumes, and deposited in windrows radiating from the elevating tower. Some of the piles attain a height of 200 or more feet and cover a sizable ground area. Considerable use is now being made of the stone for railroad ballast.

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IN THIS ISSUE

TAKING up where he left off two years ago, R. C. Rowe resumes his account of the development of mining in Canada. Having previously covered the activities in Ontario and Quebec, he now sweeps across the continent to British Columbia, scene of Canada's first gold discoveries. The current article is the first in a series of five which will trace the growth of placer and lode gold mining in British Columbia and the Yukon. He may later tell the story of copper and other base metals in the same provinces. We also have Mr. Rowe's promise that he will eventually write for us the history of Canada's great nickel-producing industry. As evidence of the thoroughness of Mr. Rowe's research we record the fact that not a single statement in his previous series has been challenged.

●

THE fact that every rock-drill manufacturer in the world still utilizes the basic principles on which the original Leyner hammer drill was designed is the greatest tribute that can be paid to the genius of J. George Leyner. The story of Leyner—both the man and the company he built—is told in this issue. Many parts of it are personal, and purposely so, because we believe that all rock-drill users will be interested in knowing the human side of the Colorado mechanic who contributed so much to the art of drilling rock.

●

LARGE construction jobs in the United States have been given so much publicity in recent years that one would almost think this country has a monopoly on them. That such is not the case, however, is evidenced by the fact that the new Albert Canal that is now nearing completion in Belgium will cost $500,000,000. Although their purposes are radically different, there is one striking point of similarity between the Albert Canal and the All American Canal in this country, and that is that, among other considerations, they were built to replace previously constructed waterways that partly traverse foreign soil.

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Gold Mining in British Columbia

R. C. Rowe

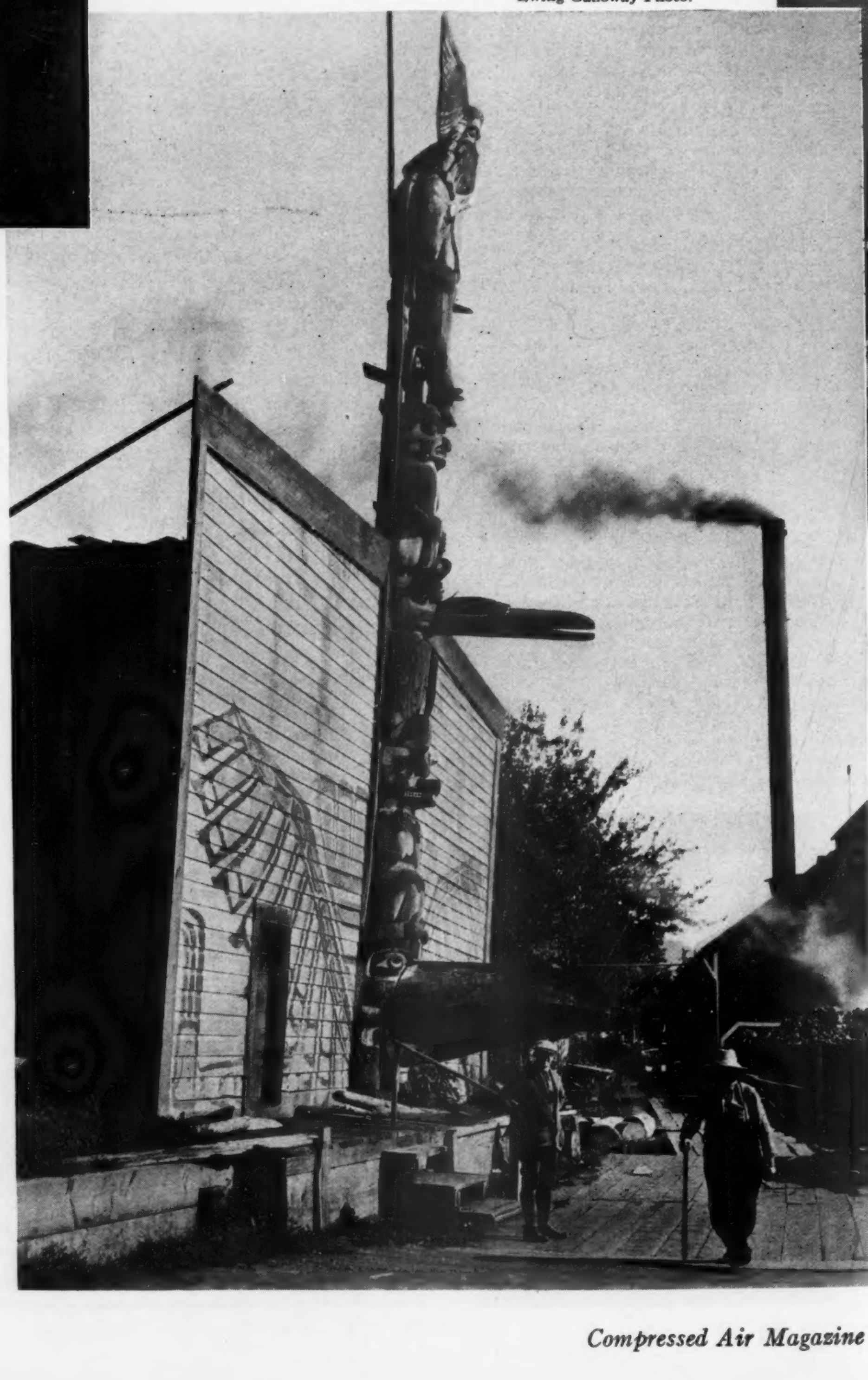
THE CLEAN-UP

The pan contains $9,000 worth of gold taken from the sluice boxes of a placer-mining operation on Dragon Creek, one of the best-producing streams in the Barkerville District during recent years.

A LINK WITH THE PAST

Tenure of British Columbia by white men has been comparatively brief, and much of it remains essentially as it was when the Indians held it. Among the surviving evidences of aboriginal rule are totem poles made up of carved and often brilliantly colored images representing the totems of a particular tribe or clan. An Indian's totem—usually a plant or animal—was considered to bear an intimate relation to him, and he held it in such reverence that he would not harm, destroy, or eat it. Intermarriage between persons having the same totems was not sanctioned, even though they had no blood relationship and lived on opposite sides of a continent. Thus totemism had both religious and social significance. The totem pole pictured below is at Alert Bay, Vancouver Island.

Ewing Galloway Photo.



Foreword

SOMETIME ago the writer contributed to COMPRESSED AIR MAGAZINE a series of articles which constituted a history of mining in the provinces of Quebec, Ontario, and Manitoba from about 1903 to 1935. In the main, it dealt with the course of events which was set in motion by the discovery of Cobalt in 1903. In addition to being a historical narrative, it sought to show that mining development in a geographical sense, is usually the result of a progressive advancement which uses each discovery, as it is made, as a center for further exploration and effort. In the previous series that point was fairly well established.

Canada, however, is a country of great distances, and it also presents vivid topographical differences. It has three distinct mineral areas, each of which is unlike the others in topography and geological structure. These differences obviously affect mining development. The first of these mineral regions is that bordering the Atlantic Ocean and embracing the Maritime provinces. It is known as the Appalachian area. The second is the vast expanse made up of northern Quebec, Ontario, Manitoba, and Saskatchewan, together with Northwest Territories. It is known as the Pre-Cambrian area. The previous story dealt with developments in the three first-men-

Photo from National Parks of Canada

VANCOUVER HARBOR

A view looking eastward, showing the splendid water basin and the manner in which it has been improved to facilitate shipping. Vancouver, which was laid out by the Canadian Pacific Railroad in 1885, is the fourth largest city in Canada and the second most important seaport in the country. It is nearer the Orient than any other North American port and is the terminus of many steamship lines. Mining activities first attracted people to British Columbia in great numbers and, accordingly, was largely responsible for the founding and growth of Vancouver.

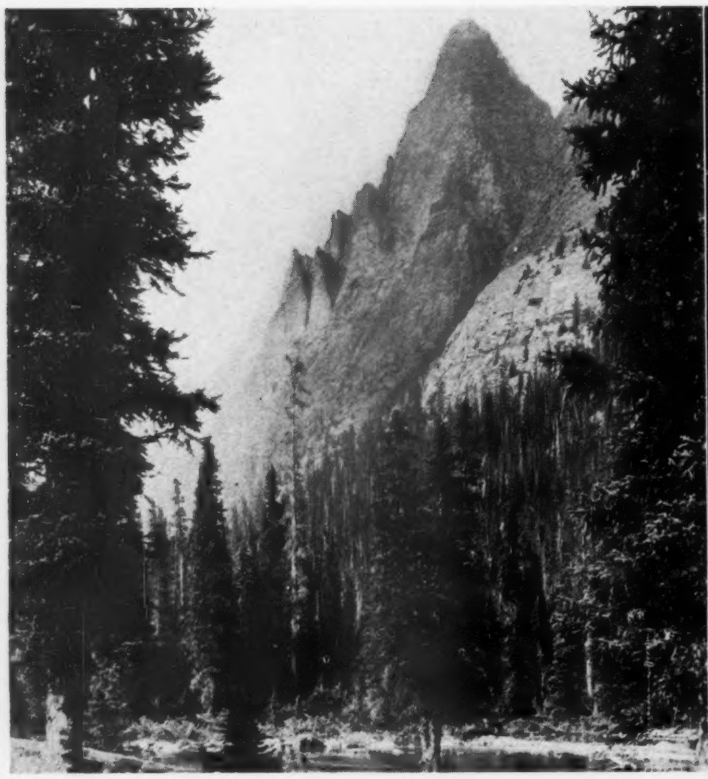
tioned provinces in this region. The third great area, known as the Cordilleran, is washed by the Pacific Ocean, and within it lie the Province of British Columbia and the Territory of the Yukon. It is with the course of events in British Columbia and the Yukon that we are now concerned.

While distinct from one another, the differences in the case of the first two areas are not so marked; but between the Pre-Cambrian and the Cordilleran they are about as great as they can be. In one thing, however, they are alike. Both have made vast contributions to the development of Canada: both have poured large sums of money, through the liquidation of their mineral wealth, into the economic lifeblood of the Dominion. But beyond that, similarity ends.

The Pre-Cambrian is in the nature of a vast plateau of low reliefs. In fact, it is often known as "The Pre-Cambrian Plateau." In some parts it flattens out almost to a plain, heavily timbered, with shallow lakes and sluggish rivers. In others it is broken by low, rolling hills stretching for hundreds of miles, presenting an almost interminable succession of rounded hills and narrow valleys. Throughout, it is a country of thousands of lakes and watercourses. These offered excellent travel routes for many years and enabled adventurers of all kinds to penetrate the region for great distances. Down the waterways of northern middle Canada came the

LAST year British Columbia's mineral production attained a new peak with a value of $74,000,000. Lead and zinc, which sold at relatively high prices during that period, accounted for almost one-half of the total. The gold output amounted to $18,000,000 of which $16,500,000 was contributed by lode mines and the remainder by placers. These figures tell the story of a thriving industry that was born 86 years ago when an agent of the Hudson's Bay Company at Kamloops bought placer gold from an Indian. Thereupon followed a quest for the yellow metal that ascended the Fraser River and spread thence to various parts of the province. At first all gold came from placers: later lode mines were developed.

Continuing the history of Canadian mining by R. C. Rowe that was begun in this magazine in 1935, we now present the first of five articles on the past and present gold fields of British Columbia. Inseparably interwoven in the narrative is much history of the province itself.



Photos from National Parks of Can

BRITISH COLUMBIA IS A LAND OF TOWERING PEAKS . . . OF PINE-CLAD SLOPES . . .

treasure of fur, which was the first of her great natural resources to be developed, and the logs of the lumbering era. Later, up these same watercourses journeyed the prospectors and pioneers whose discoveries were destined to startle the world and eventually to bring Canada to the forefront of the metal-producing nations of the world. In our own days and times, the innumerable lakes have provided ideal landing places for airplanes—man's latest and quickest mode of transportation.

British Columbia and the Yukon, on the other hand, are lands of imposing mountain ranges and terrific vistas, of great rivers and numerous glacier-fed streams. Every variety of topographic arrangement is to be found within them; and travel presents difficulties that call for the highest qualities of physical endurance. Furthermore, for years they were more isolated, so far as eastern Canada is concerned, than Europe. In a manner of speaking, they grew up independently, and it was not until the Canadian Pacific Railway was completed in 1885 that direct communication between British Columbia and the rest of Canada was established. Under such conditions it is not remarkable that the history of mining in that province is a story by itself. Exploration there owed its birth not to any stimulus derived from eastern Canada but to events that were peculiarly its own; and for a long time development proceeded as it would have done had British Columbia been an ocean-girt continent.

Taken generally, the history of mining in British Columbia is a fascinating story full of the flavor of high adventure. This is partly attributable to the fact that placer gold plays a big part in it, which is another point upon which the Pacific province differs from the rest of Canada. British Columbia and the Yukon are the only two sections of the country where placer mining has been and still is being carried on to any extent.

Placer gold always has intrigued the fancy, tickled the cupidity, and stirred the souls of intrepid men, and undoubtedly always will, at least so long as they can exchange the yellow metal for the things they crave, be they wise or foolish. In placers, the forces of nature have freed gold from the inclosing rocks—have done all the work that men and machines do in winning gold-bearing ores from the depths of the earth and then in releasing their stored treasure. The precious metal is there in its free state, stored in the gravels that formed the beds of old streams, waiting to be taken. Placer mining in its first stages is poor-man's mining. Almost anyone with the aid of luck, a little ingenuity, and his own strength and endurance, may win a fortune for himself. Many have done it: many have not. Actually, if the truth were known, placer mining, while it has probably attracted more men, has enriched fewer than any other form of mining.

Be this as it may, the fact remains that placer mining has played a prominent rôle in the history of British Columbia. It provided the first sparks that set men seeking, and it started the province on the path which has led to its present commanding position as a metal producer. Gold rushes to new placer fields focused world attention upon it and drew prospectors who first washed gold from its streams and then started to look for the mother lodes—the sources of the yellow metal in their pans and rockers.

For this reason placer mining must form a big part of this story; and because there is such a decided difference between it and lode mining, it deserves a special chapter. Dealing with the subject in this way necessarily involves some overlapping as to the element of time because, in the later phases of British Columbia mining history, developments in placer and lode mining synchronized. However, the very nature of their differences must always keep them apart. As we view them, they take on the character of two distinct dramas being enacted on the same stage at the same time—and as such we shall treat them here.

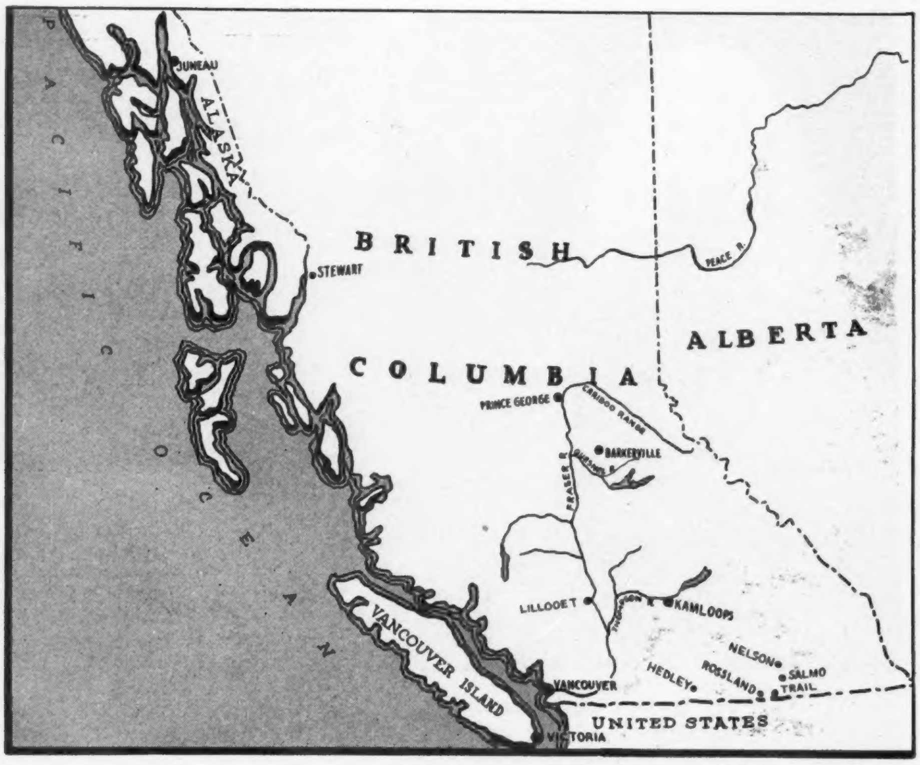
I

Placer Mining in British Columbia

BEFORE reviewing the history of placer mining in British Columbia, it is interesting to glance at the position of that province about the middle of the nineteenth century because the existing conditions had some bearing on events connected with the beginning of mining there. In days gone, the mountainous territory which eventually became British Columbia was something of a bone of contention. Four nations have laid claim to it; and when those claims were pressed they were based only on acquisi-

of Cana

OF STILL WATERS



BRITISH COLUMBIA

Since the days of the first discoveries, the major portion of the placer mining has been concentrated on the upper reaches of the Fraser River, with Barkerville the general center of operations. The first lode mining in the province was done near Nelson, where the Poorman Mine, a silver property, was opened in 1887. Gold-copper ore was found near Rossland in 1891, and the ores of that district nurtured the great reduction works which the Consolidated Mining & Smelting Company now operates at nearby Trail. The Premier Mine, which became the greatest gold producer in the province, was opened up near Stewart in 1921. The big Missouri is in the same area. Between 1904 and 1920, the Nickel Plate Mine at Hedley yielded profits amounting to $4,000,000. The Bridge River District, centering around Lillooet, became active in 1928. Bralorne Mines, Ltd., with an output of around 500 tons daily, is its most important mine. Several good producers, among them the Kootenay Belle, Reno, Relief, and Sheep Creek, are located in the area around Salmo.

tiveness, because little was known of the country and it was generally considered to be an inhospitable territory peopled by a few scattered Indians of ferocious habits. The first nation to pay any particular attention to the region was Spain, whose hardy and inquisitive mariners apparently visited the coast in the late sixteenth century. In 1774 they were back again, and some sixteen years afterward they actually established a garrison at Nootka. This was subsequently abandoned. The Spaniards, it seems, were not enamored with this north country which differed so much from the sunny lands to the south. Anyhow, so far as can be determined, they never made any serious efforts to acquire the territory.

At that time the Spanish assessed the value of regions open to conquest by their gold possibilities, and they were probably still of the opinion voiced at the Spanish court when the French were fitting out expeditions to North America. History has it that Philip of Spain, hearing of French activities in North America, became a little worried as to whether he might not be passing up some bets. He therefore commissioned one of his diplomats, or private agents, to pay a visit to the French court with the object of gleaning some information about those activities.

The envoy must have been a man of parts, for he managed to get himself invited to a dinner which the king of France was giving to that stocky adventurer, Jacques Cartier, who had completed one voyage to the northern land which eventually became Canada. Following the custom of his times, the king became a little drunk and began to talk too much. In his private report to Philip of Spain, the diplomat related how annoyed Cartier became at his sovereign and how he attempted to shut him up. But Louis was not to be denied, and recounted tall stories about gold that was apparently to be had in New France for the picking up. In the end, however, the Spaniard was not impressed, and seemingly of the belief that the French were throwing a lot of money away on a wild goose chase. He intimated as much to his royal master when he wrote in his report: "As Your Majesty well knows, gold does not grow in cold countries." It was probably that idea that made the Spanish desert a region to which they had paid a great deal of attention.

In 1778, the famous British explorer Captain James Cook made the first survey of the coast line. This work was continued during 1792 to 1794 by Captain George Vancouver, after whom Vancouver Island and the City of Vancouver were named. During that time, owing to those surveys, the territory had a sort of nebulous place in British North America, for the boundary between New Caledonia, as the territory was named, and the Pacific parts of the newly formed United States of America had not been defined. The Russians, who had penetrated the region during the eighteenth century, also laid some claim to it. They were familiar with its fur possibilities, and their traders had apparently covered it extensively. Their demands, however, never got beyond the mild-negotiation stage.

In the late part of the eighteenth and the early part of the nineteenth centuries, the fur traders of the Northwest Company and of the Hudson's Bay Company penetrated the country and established posts here and there, and for many years the only white inhabitants of the vast area collected at those posts. Like the early fur traders in outlying regions, the factors of the posts—or forts, as they were called—became the rulers of the land, maintaining law and dispensing justice. It might be remarked in passing that the record of the great fur-trading companies in this respect is a remarkable one, and the fact that their factors maintained the prestige and property of their companies in districts far removed from established law and order speaks worlds for the manner in which they exercised their unwritten authority. Emphasis is placed on this point here because it was


HYDRAULICKING

Current scenes in the Barkerville District. Streams of high-pressure water, directed through monitor nozzles, dislodge the gravel and carry it to sluice boxes which trap the gold. The view at the left shows a monitor at close range and conveys an idea of its size. The monitor is mounted so that it can be swung in a horizontal plane to vary its point of attack.

this authority wielded by a Hudson's Bay Company factor that was the only barrier between order and unlicensed lawlessness in the days when mining in British Columbia was in its infancy.

Early in the nineteenth century the question of the boundary between the United States and British North America began to assume an ominous tinge. All other claims to the mountainous area seemed to have been eliminated; but the Americans demanded the whole area clear up to Alaska, while the British claimed it as far south as the mouth of the Columbia River. Naturally, in view of such divergent claims, feeling began to run high, though it is really hard to see why, inasmuch as the territory was quite unknown at that time and so far as the disputants were aware was of little value except as a source of furs. But in spite of this, the slogan during the 1844 election in the United States was, "Fifty-four forty or fight," meaning, of course, that that latitude was the dividing line upon which the Americans would insist. Fortunately, however, better feeling prevailed in the end; and in 1846 the 49th parallel was fixed by treaty as the boundary.

In 1849, Vancouver Island was made a Crown Colony of Great Britain, and its first governor was the chief factor of the Hudson's Bay Company. His name was James Douglas, and he controlled all its activities both on the island and the mainland. At this distance it seems not unlikely that that great fur-trading company brought some pressure to bear on London when the matter of governorship was being considered, for it was preferable, obviously, to have its own man in charge of constituted government on Vancouver Island rather than an outsider who might, quite reasonably, contest its authority. Be that as it may, the fact remains that the choice was an excellent one. James Douglas, who was later appointed first governor of British Columbia, was a remarkable man, and one singularly fitted to control the destinies of the outpost of an empire.

Thus, in 1850, the Island of Vancouver had a loosely organized government. The mainland was a wilderness with only a few trading posts and was mostly unexplored. What government it did have was vested in the unwritten authority of the Hudson's Bay Company and its chief factor. James Douglas was therefore governor not only of the island but also of the mainland, in one case by appointment and in the other by usage. That was the condition in the years during which destiny was shaping events which were to have a vital effect on the history of the Province of British Columbia.

The actual date of the first discovery of gold in the territory which is now British Columbia will never be known. That Hudson's Bay Company agents had heard of the presence of the precious metal for some years prior to its recorded discovery seems to be certain, and it is reasonable to assume that, in line with their policy of discouraging outside interest in the regions in which they traded, they did not advertise the fact. They knew that gold attracted men, and that men brought all the interference of the outside world. They knew also that fur disappeared like mist before the morning sun in the face of such interference and noise, and as their business was fur, they kept quiet. It is a matter of record, however, that the agent of the Hudson's Bay Company at Kamloops bought gold from an Indian in 1852—an incident that is of interest only because it came to light years after and because it shows that the Indians had knowledge of the precious metal and some idea as to its value. In 1855 a find was made just south of the international boundary, and this created some attention.

It seems to be fairly well established that the year 1856 witnessed the discovery which started New Caledonia on its way to becoming British Columbia and a mining country of considerable note. We have no less an authority than James Douglas himself for the truth of that statement. The worthy governor, though he had no jurisdiction over the mainland, certainly knew everything that transpired in that vast territory, and recorded in his diary that gold was found on the bed of the Thompson River in 1856 by an Indian who (to quote the words of Douglas) was "quaffing from the stream" when he noticed "a shining pebble" which turned out to be a gold nugget.

There is really not the slightest reason to doubt the truth of this legend; but it is so customary to clothe mineral discoveries with the glamour of accident that we advance the theory that the Indian might possibly have been looking for gold. It is reasonable to suppose that the natives knew of the existence of the yellow metal in certain streams, and it is equally reasonable to suppose that they kept a weather-eye open for it in their travels. One way or the other, gold was found in the Thompson River that year, and the Indian told his fellows, because Governor Douglas wrote in his diary that "the whole tribe forthwith began to collect the glittering metal." The success of their efforts is attested to by Mr. Hamilton, a factor of the Hudson's Bay Company, who reported that Chief Trader MacLean at Kamloops "had two pint pickle bottles 'half full of gold" taken from the Thompson River that season. Thus the first recorded gold resulting from systematic search in British Columbia was kept in so prosaic a receptacle as a pickle bottle!

POOR MAN'S MINING

Placer mining offers any able-bodied man a chance to make a living and, if he is fortunate, he may do even better than that. Unless he has capital with which to buy mechanical equipment, he must do most of the work by muscular effort. These pictures, showing present-day operations in British Columbia, illustrate the simple methods and apparatus that are used.

Evidently, the Indians who poked about in the bed of the Thompson River were not so reticent as they might have been, because the news leaked out, and the next year some Canadians and half-breeds worked their way into the territory and found placers at Nicoamen, 9 miles above the junction of the Thompson and the Fraser rivers. During 1857 some 300 ounces of gold, the product of the workings in question, passed through the hands of the Hudson's Bay Company.

Meanwhile Governor Douglas, over on Vancouver Island, was keeping in close touch with developments. It is probable that he viewed them with some misgiving, and in his imagination saw the silence of his wilderness domain shattered by the clamor and frenzied activity of the hordes that the precious metal would inevitably attract. If he had such visions it is certain that he became apprehensive, for, even though he was governor of Vancouver Island, he was still the chief factor of the great company and its loyal servant. In fact, one historian has wondered whether the subsequent movements of James Douglas were those of the governor or of the factor.

In any case, he took steps to meet the situation. We have previously pointed out that he had no jurisdiction over the mainland—in fact, so far as can be determined, no one had. Apparently, that did not mean a thing to Douglas. Being a direct and fast-moving man, he simply assumed authority to govern the area in fact as he already had governed it by usage, and issued the first mining proclamation of British Columbia. Early in 1858 came the deluge. At the beginning of that year the population of Victoria was about 300 souls. Vancouver was a mere collection of huts, with perhaps a jetty on mussel-bound piles. The mainland was unexplored save for the journeyings of such intrepid men as Simon Fraser and Alexander MacKenzie (Scotch names have played a great part in Canadian history), and it was mainly uninhabited except for its native Indians and a mere handful of white men who lived at the scattered fur-trading posts.

To trace the sequence of events set in motion by the discovery of gold on the Thompson River it is advisable to consult the accompanying map. It will be noted that the Fraser River enters the Pacific Ocean at Vancouver. Following it upstream we go east for some distance and then almost due north until Prince George is reached, whence we travel east and south to its source, Some distance beyond the point where we turned north the Fraser is joined by the Thompson River. It was a few miles above this junction that gold was found on the Thompson river. At Kamloops, the Thompson splits into the North Thompson and the South Thompson. With this geographical excursion in our minds, we can return once more to the matter of history.

It is almost certain that the finding of gold in New Caledonia would not have created such a furore if the gold fever in California had not been at its height. As it was, a great mass of people were in the correct frame of mind to respond to the lure of new discoveries. The news seems to have been obligingly conveyed to the outside world by the captain of a coasting vessel. His name was Captain Jones; and no less an authority than the late Robert Dunn, who was for many years Deputy Minister of Mines for British Columbia, stated that the worthy captain was quoted in a newspaper (with the sonorous name of the *Pioneer and Democrat*) to the effect that gold had been found at a place called "Hill's Bar" on the Fraser River. That was on March 5, 1858.

In a very short time the rush was underway. Thousands came from California, sailors deserted their ships and soldiers their regiments. By May it was computed that 15,000 men had reached the diggings, and this number was rapidly increased until 20,000 were reported to be encamped at Yale on the Fraser River. Some of those hordes came overland; but most of them followed the water route, and it is easy to image that the hardships endured were terrific. The Fraser is not a placid stream, and there is no doubt that its tempestuous waters closed over a great number of the adventurers. In fact, James Douglas, in his carefully kept diary, informs us that many of them "have been swept into

A DEEPLY CUT VALLEY

A typical British Columbia placer-gold stream—one of the many up which the pioneer fortune hunters made their way.

Eternity." One suspects he was not sorry.

But in the face of obstacles and hardships the waves of humanity swept into the new Eldorado. After the manner of such things, it was the fittest and toughest that survived; and it requires no stretch of the imagination to realize that, in this great collection of hard-bitten adventurers, there were the seeds of vicious lawlessness. In such a rush into unorganized territory, disputes as to boundaries of claims were inevitable; and the fact that there was no law and no court of appeal except force bred a situation which was fraught with vicious possibilities. Added to this was the fact that many of the gold seekers were from California which had witnessed similar conditions only a few years before. Those men had seen the rise of community government which, while it contained a rough-and-ready justice, had a tendency to act in the heat of the moment rather than in the cold light of reason.

Over this scene of dire potentialities loomed the figure of James Douglas, Governor of the Crown Colony of Vancouver Island. We have learned enough about the worthy governor to realize that he was hardly the type of man to let a technicality deter him in the face of an emergency. He was an excellent example of the type of British administrator who has built up a far-flung empire by acting first and then asking for instructions afterwards. Being just that, he calmly extended his authority to the mainland by the simple expedient of taking charge. As we have already said, there is little doubt in the minds of historians as to whether he was acting in the interests of the Crown or of his company; but in the great sum of things it really makes little difference because his actions were for the common good.

As we look back we can see that he had little enough to work with beyond his own forceful personality. Means of actual coercion he had none; but he did persuade the naval authorities at Victoria, the capital of Vancouver Island, to station a gunboat at the mouth of the Fraser River. This, in itself, was no mean accomplishment, for naval men are notorious sticklers in matters of technicality. With that show of power at a strategic point, he journeyed up to the diggings and laid down the law in no uncertain terms to the motley army of gold seekers.

Thus, in a quiet, forceful way he upheld British sovereignty over the new source of wealth; and back of it all was the undeniable fact that at the mouth of the great river which represented the road to the sea was one of Her Majesty's ships which could, if necessary, cut off all the supplies that were the very lifeblood of the new camp. It was a wonderful example of the iron hand under the velvet glove. Thus James Douglas brought law and order to a territory that was technically without government beyond that imposed by the shadowy and distant sovereignty of Her Gracious Majesty Queen Victoria of Great Britain.

Naturally, the British in their own quaint way severely criticised James Douglas for acting on his own initiative. The House of Commons had an acrimonious debate on the subject; but just to be sure that there could be no mistake about the matter, and that the comments upon the behavior of James Douglas would not be taken too seriously, the Crown Colony of British Columbia was proclaimed in November of 1858 by an act passed by the gentlemen of Her Majesty's Commons, and James Douglas was appointed governor of both the new colony and that of Vancouver Island. Thus the technicality was removed, and the man who had acted so promptly was officially confirmed in the authority that he had usurped. Late in the same year Judge Begbie was assigned to the area as justice, and the force of British law was represented by a detachment of the Royal Engineers who arrived early in 1859.

Before passing from this drama, it is interesting to speculate on what might have happened if James Douglas, single-handed and without official backing, had not upheld British sovereignty in a land which was entirely without constituted authority and which was filled with men who were Americans, and hard-bitten lawless men at that. Had he stood aloof, it is conceivable that the territory which is now British Columbia might have passed from British control.

It was inevitable that there should be disappointment in the wake of so dramatic a rush, and, as a consequence, excitement subsided rapidly. So rapidly in fact that by the end of 1858 all but 3,000 of the adventurers had left the country. It is apparently almost a fundamental law that any really important movement in the political, social, or economic realm is featured by a surge of activity and feeling followed by a recession that carries with it an overpowering sense of futility and uselessness. It also seems as though real progress is effected only during the period following recession. This is probably due to the fact that constructive forces are actually at work all the time and become apparent only when the obscuring mists of wild optimism or mad excess are removed.

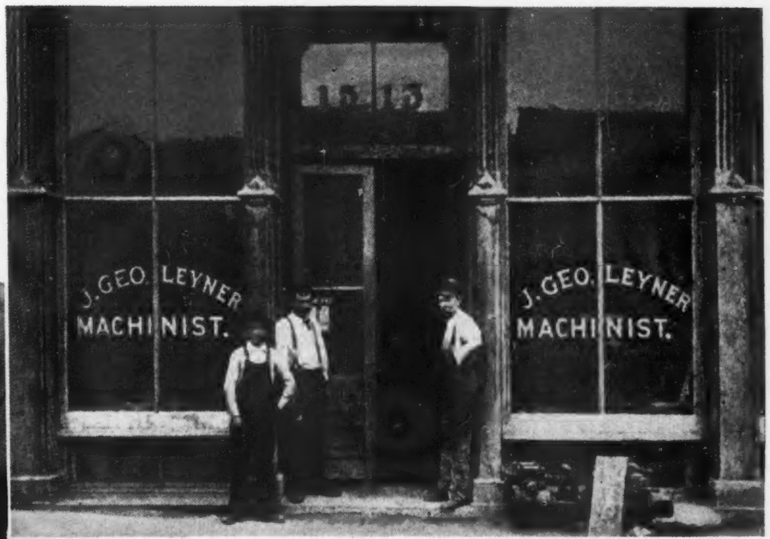
All history is full of examples of this sequence of events in the wide theater of world affairs during broad sweeps of time, and gold rushes often afford further examples in the narrower field of domestic affairs. The first gold rush to British Columbia was a wild event—a thing of impulses and instincts. It flared up quickly and died away quickly. There is not the slightest doubt that many a wise man of that day shook his head and mentally dismissed the whole matter as one of those incomprehensible minor madnesses that sweep over mankind for no particular reason. But, of course, those wise men were wrong, as wise men often are, because the gold rush to the Fraser had brought some solid elements to British Columbia as well as a lot of froth and scum, and some of that element stayed. Those men moved ever onward up the rivers, spreading out along tributary streams, seeking and looking, and in the course of time brought to British Columbia her birthright of metals.

That spreading outward from the bars on the Fraser and the lower Thompson was not entirely the result of the age-old urge of men to explore unknown rivers and unnamed mountain ranges. It was, to some extent, based on a theory, and a reasonable theory at that. The placer miners of that day contended that the gold they had been working originated far up the streams and, therefore, that further search would lead to new discoveries. In that respect they were right; but they were only partly right in their deductions regarding the origin of the Fraser River gold. Anyhow, the combination of *Wanderlust* and reason drove them up the mighty Fraser in the face of difficulties that were appalling, the only redeeming feature being that game was plentiful and death by starvation remote in consequence. However, practically every other form of untimely decease was present.

This is the first of a series of articles by Mr. Rowe. The second will appear in December.

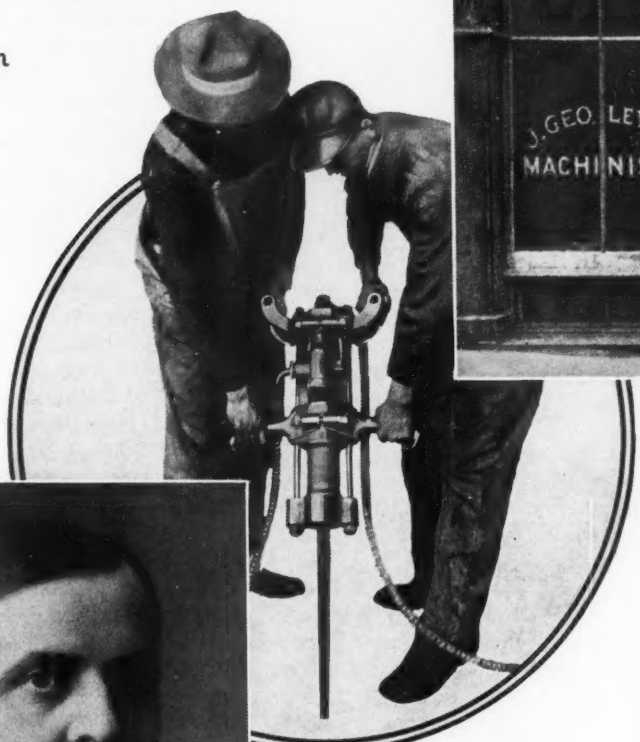
J. George Leyner—Drillmaster

J. D. Ditson



LEYNER'S FIRST SHOP

About 1887, Leyner moved to Denver from Longmont, Colo., and bought an interest in a machine shop on Wazee Street. He acquired full ownership of it in 1891, and this picture was taken shortly afterward. Leyner is the middle figure. The shop specialized in machine work and the making of models and patterns. Much mining machinery was brought to it for repair, and Leyner therefore had a chance to familiarize himself with rock drills. He was soon suggesting improvements on existing piston-type drills and designed one of his own in 1893 and placed it on the market. By 1896 he had worked out the details of a hammer drill, for which he is chiefly known. It was offered to the trade in 1897. By 1900 it had been so generally accepted that Leyner discontinued making piston-type drills.



JOHN GEORGE LEYNER

This picture is probably the last one taken of the father of the hammer drill before his death in 1920. In the circle above is a No. 7 Leyner drifter drill taken at the Leyner plant around 1910 and showing how handles were attached to it to convert it into a hand-held tool for down-hole work. Shortly after acquiring Leyner's patents in 1912, Ingersoll-Rand Company brought out the first Jackhamer, a machine that was specially designed for its field of application and that required only one man to operate it.

IT is generally conceded that John George Leyner was the father of the hammer-type rock drill. True, C. H. Shaw introduced a hammer drill for stoping work somewhere around 1890, but it was Leyner who first applied the hammer principle to drills for horizontal and down-hole work and undoubtedly developed the hammer drill to a point where it was a practical machine. Until he put his first "Water Leyner" on the market, virtually all mechanical drilling was done with piston-type machines despite the fact that several patents had been issued on drills using the hammer principle.

It is interesting to note that most of the pioneer work that resulted in the success of hammer drills and of hollow drill steel was done in Denver, Colo. In addition to Leyner and Shaw, record has it that D. S. Waugh, Walter and Brothers, and Illers were engaged in the same line of endeavor during the same period. For that reason it is hard to say with certainty just who really originated the hammer drill. Competition among them was keen, and there was probably much pirating of ideas; but there is no doubt that Leyner was the leader in applying those ideas to commercially successful drills.

Leyner was born on his father's ranch in Left Hand Canyon, Boulder County, Colo., on August 26, 1860. He was the second white male child born in what was then Colorado Territory and thus truly a pioneer as regards both nativity and, later, activity. His father, of German descent, was a native of Dachenheim, Germany. His mother came from Dutch stock and was born in Pennsylvania. John George was the oldest of seven children. He attended rural public schools and spent the rest of his boyhood years working on the family farm. At most, he had no greater academic education than the eighth grade of our present school system; but what he lacked in book learning he made up in sound judgment and in practical experience—the best teacher.

The only phase of farming that interested him was the limited mechanical equipment that was then in use; and it was but natural that he should turn to pursuits more to his liking. In 1883 he obtained engineering employment with the Jackson Mining & Milling Company at Black Hawk, Colo., which was at that time one of the boom camps of historic Gilpin County, the cradle of Colorado's gold-mining industry. He gave up that job in 1884 for another one with the Canfield Flour Milling Company in Longmont, Colo., where he worked for about a year, again in an engineering capacity.

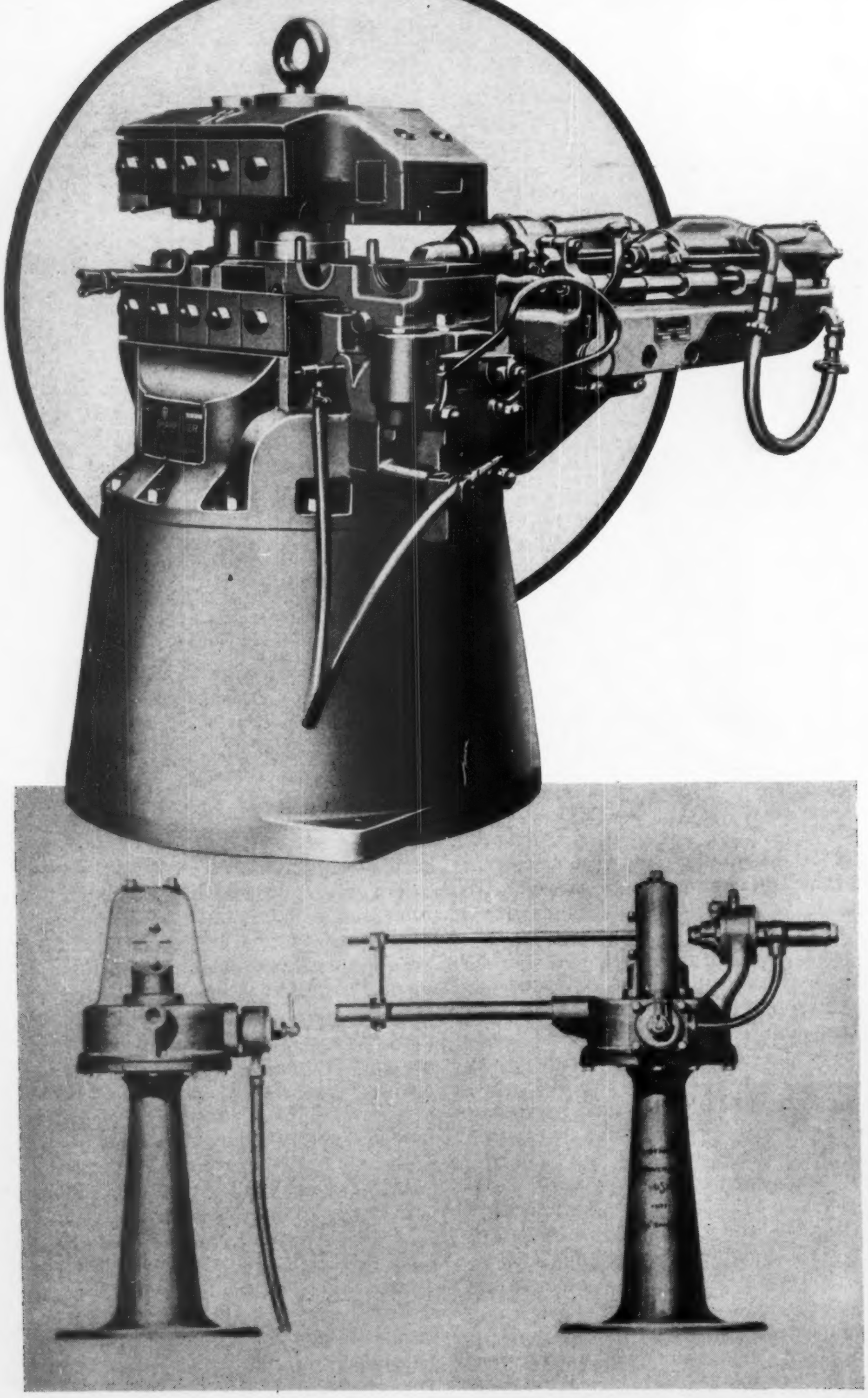
In 1886 he became associated with a small machine shop and foundry in Longmont. The town was of modest size and depended solely on the surrounding agricultural area for existence, so there was little opportunity for such a business to expand. Because of these limitations, Leyner soon went to Denver, where he bought an interest in a small machine shop at 1513 Wazee Street. In 1891 he acquired full ownership of the business. As it was devoted chiefly to the repairing of mining machinery, it was undoubtedly there that he laid the groundwork for his later activities.

Rock drills seem to have held great interest for him from the start, and he soon began suggesting improvements on existing models that came into the shop for repairs. After but two years, in 1893, he designed a piston drill and began manufacturing it.

Although the drill was in many respects similar to others then on the market, it apparently met with considerable success, for in 1894 Leyner moved to larger quarters at Seventeenth and Wyncoop streets. Shortly afterward—the exact time is not known—he began developing a hammer drill. Meanwhile, his piston drill continued to be popular, and about 1895 he developed a line of air compressors to supply power for drilling work.

The few drawings of Leyner's first hammer drills that are still available indicate that his ideas were well crystallized by 1896. Shaw was already making hammer-type stoping drills, and most of the others previously mentioned also were apparently playing with the hammer-drill idea. Leyner's earliest drills of this type departed considerably from the prevailing practice. He discarded the rifle-bar rotation that was used on piston drills, but subsequently had to revert to it. By the early part of 1897 his drill had reached the point where he decided to put it on the market. He sold about 75 of them, all of which were designed to blow a blast of air through a hollow or channeled drill steel for removing rock cuttings from the hole. After these drills had been in use a short time, workmen refused to run them because they raised so much dust. As Leyner had guaranteed them, he took them back even though it was a financial blow that put him on the verge of bankruptcy. He was convinced, however, that he was on the right track and would not admit defeat.

He set to work to find a solution of the dust problem, and finally decided to pass



FIRST AND LATEST SHARPENERS

Among Leyner's varied contributions to machinery in the rock-drilling field were important improvements in the design of drill-steel sharpeners. He began work on this class of machinery in 1902, dropped it for a time because of other interests, and resumed it in 1907, when he brought out three sizes to handle a wide range of bit sizes. Two views of his No. 1 model are shown in the lower picture. This sharpener became immediately popular. New models were brought out by Leyner from time to time until his concern was fully taken over by Ingersoll-Rand Company in 1922. Since that time the latter firm has continued to utilize the basic Leyner design while adding improvements and refinements. One of the latest units, the IR-54, is pictured at the top. It has an air reservoir in its base and embodies equipment for forming bits up to 3⅝ inches in diameter and shanks of any type on any section of standard steel up to and including 2-inch round. It will form new bits at the rate of 30 to 60 an hour, resharpen 60 to 100 bits an hour, and make 25 to 50 standard shanks an hour.

water along with air through the drill steel. The drills were modified accordingly and returned to the field. As the water allayed the dust there were no further complaints, and the new drills quickly began to show their superiority over other existing types. Leyner obtained a patent on the commingling of air and water in the drill steel; and this patent later proved to be his most valuable asset. His drills were lighter than piston drills, drilled faster, and were more efficient. In addition, his right to the exclusive use of air and water for removing cuttings from the hole gave him a tremendous advantage over any competitors that also produced a hammer-type machine.

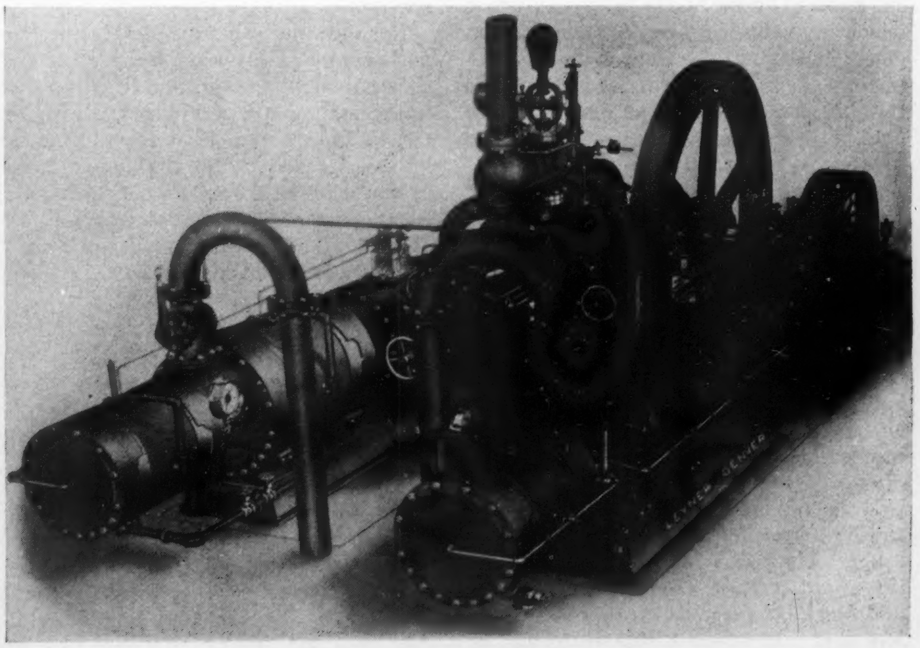
It is impossible today for one to appreciate fully the difficulties Leyner encountered in connection with the introduction of his new type of drill. All drill steel previously employed had been of the solid-bar type. In order to make his drill useful, it was necessary for Leyner to incorporate in the drill steel a tube or hole of some sort through which air and water could be passed. As no method of manufacturing hollow drill steel was then known, all sorts of schemes were tried. Not only Leyner but numerous others attempted to find a satisfactory solution of the problem. Walter and Brothers devised two different ways of making it with cruciform steel and Shelby tubing. In one case they ran a piece of small-diameter tubing down the steel between adjacent wings. The other scheme was to encase the entire steel in a larger tube. The latter idea obviously was troublesome, for every time steel lengths were changed, tubing lengths had to be changed also. Illers utilized a piece ot cruciform steel and grooved two adjacent wings to allow a strip of flat steel to be slid in, thus forming a hole of roughly triangular section. Shaw had been using a milled slot that was closed over, and Leyner had experimented with cruciform steel having a small-diameter tube welded into the space between the wings. All these ideas had drawbacks, and after a time Leyner tried to get various steel companies to roll some special steel roughly figure eight in section and with elongated sides that might be rolled over to form two small openings through the bar. He prepared drawings and specifications for such steel in 1898, but none of the mills would make it for him.

Thereupon Leyner began to manufacture his own hollow drill steel. He machined bits and forged shanks out of tool steel, drilled a hole through them, and, after scarfing the ends, welded them to the opposite ends of a length of staybolt iron. The result was a composite member with a central hole through it that accomplished the desired purpose, and Leyner continued to make steel in this manner for more than ten years. One of his former employees recalls that after one man had welded on the two end pieces another man would attempt to break them off with a sledge hammer. If they remained intact the steel passed inspection and was shipped.

While he was working on his new drill, Leyner was also expanding his business in other directions. Improvements were continually made on his compressors, which were meeting with success. Among the betterments were the adoption of automatically operated poppet valves and the inclusion of a system of intercooling and aftercooling the air. For the latter purpose tubes were placed in the water jackets, and the air, in passing through them, gave up its heat to the water that was primarily used to cool the cylinders.

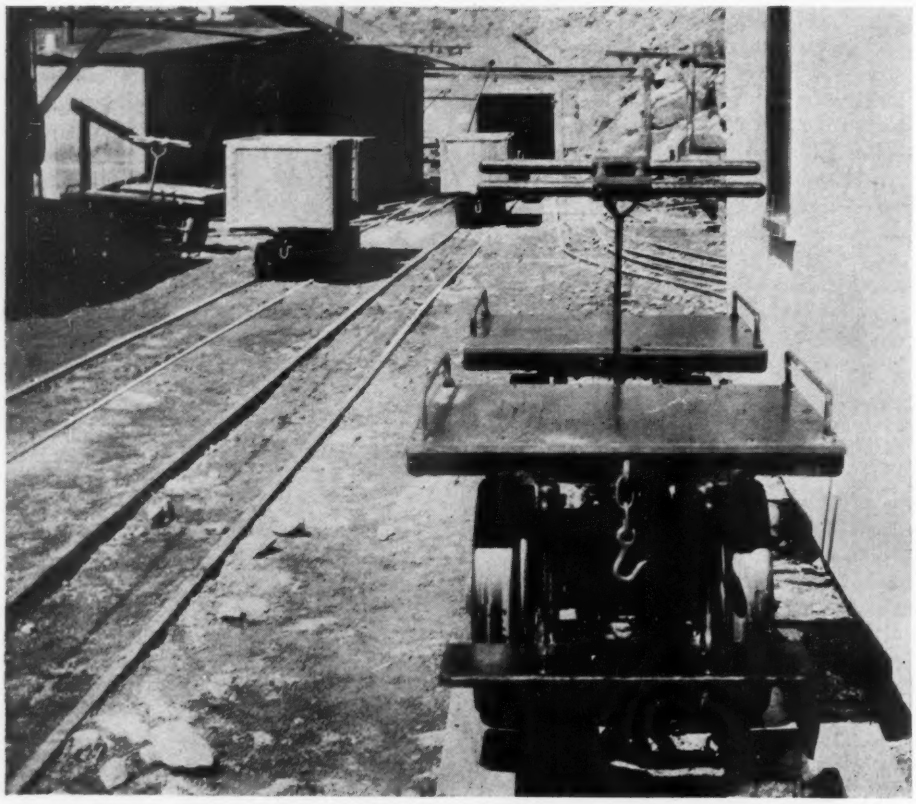
In addition to manufacturing drills and compressors, Leyner began to make hoists and other equipment for mines on which he was asked to submit bids. In 1898 he found that he needed more room, and moved his plant to Thirty-sixth and Wazee streets. At the same time he established his offices in the Old Albany Hotel at 729 Seventeenth Street. In the following year he issued a catalogue in which he advertised steam and belt-driven compressors, rock drills, and associate machinery. His business had expanded to a point where it was beginning to be an important manufacturing concern, and it seemed that most of his difficult development problems had been solved.

Looking back, it is evident that up to 1900 Leyner was laying the foundation for his later success. In nine years he had designed and developed his new drill, added considerable associate equipment, established his business in consistently larger quarters, surrounded himself with extremely capable men, and begun to make money. He was ready to reap the harvest of his pioneering if he could keep things going. That he could keep going seemed assured by the character of the subordinates he had selected. All the members of his staff were able men, and they apparently understood his gruff nature. This was particularly



LEYNER COMPRESSOR AND SHOP

As early as 1895, Leyner developed a line of compressors to supply power for drilling work. Above is shown one of his later steam-driven units with simplate valves of his own invention. To meet the requirements of his continually expanding business, Leyner built a new manufacturing plant at Littleton, a suburb of Denver, in 1903. An interior view of the main shop is shown at the left.



LEYNER HAND CAR AT NEWHOUSE TUNNEL

The Newhouse Tunnel was the proving ground for numerous pieces of Leyner-made equipment and particularly for hollow drill steel which he was developing prior to 1898 to make his "Water Leyner" drill practicable. The tunnel, now known as the Argo and still used to some extent, is a 4-mile bore between Idaho Springs and Central City, Colo. It was driven into the Divide to provide a haulageway and drainageway for various gold mines. Its construction extended over a span of fifteen years, and much of it was excavated with the aid of Leyner drills.

true of his engineer, Jesse Ditson, who had started working for him in 1893 as a pattern maker and who had been promoted to engineer in 1897, at the time of the development of the hammer drill. He was an ideal running mate for Leyner because he had the ability to turn many of Leyner's ideas to practical account. The two men worked together effectually throughout the life of the company. Ditson still resides at Littleton, Colo., where Leyner's later efforts were concentrated.

Leyner was a large man with a dominating personality and inclined to be extremely stubborn, especially when it came to overcoming the difficulties that he frequently had to face. An example of his refusal to give in when confronted with seemingly insuperable obstacles is found in the case of an accident that once befell him. While prowling around an old mine he stepped on some rotten timbers covering a shallow shaft. They gave way, and he plunged downward, striking a ladder in his descent and breaking a leg. With no one to help him, and fairly certain that there was an accumulation of poisonous gases in the bottom of the shaft, he climbed up the ladder, holding his breath until he was close to the surface. Not until later did he discover that he had broken three consecutive rungs out of the ladder in his fall and that he had climbed over that gap without being conscious of it.

In much the same manner Leyner surmounted obstacles in his business without giving thought to their size or gravity. It was characteristic of him never to admit defeat. Because of his unyielding nature his associates found their work very trying at times; but they were always loyal to him. Among them Leyner was always "The Old Man." He handled his business in a straightforward manner, and there was little red tape in the system that he instituted. Whenever he had an idea for a new product or for improving an existing one, he outlined it verbally to his engineer, and then forgot about it. That was all that was needed, and in a short time the idea was thoroughly sifted, put into effect it if was practicable, and quickly became a matter of the past. It was because of this method of working that Leyner was able to develop so many products.

The greatest period of expansion came after 1900. Leyner kept improving his machines and adding any new ones for which there was a demand. He began building larger machinery, among which were mine hoists in a complete range of sizes. He manufactured skips, mine cars, and much other mine equipment, and also carried a stock of associate products such as rails, boilers, etc., made by other firms.

In 1902 his business had again outgrown its quarters and had attained such a size that Leyner decided to incorporate it. This he did under the name of The J. George Leyner Engineering Works Company. At this time the concern was building two models of the "Water Leyner" drill—the 5A and the 5B. Leyner had discontinued making piston drills in 1900, having become firmly convinced that the hammer drill was the better type. He had also added a line of compressors driven by Pelton water wheels. In 1903 the third standard model of the hammer drill, the 5C, was introduced. It involved no radical change, and was added primarily to give the line a wider range to meet a greater variety of applications. This drill was so much like present-day drifters in design that there is no need for saying anything about it other than that it was equipped with a differentially thrown spool valve located on top of the cylinder.

It is interesting to note that in 1903 Leyner applied for a patent on detachable bits for rock drills. They would have solved the problem of drill steels to some extent if he could have developed them; but he apparently met with too many difficulties, for he did not use them to any great extent. The bits were attached to the ends of the steels by a taper fit.

With the need for further expansion of his manufacturing facilities, Leyner located a desirable site for a new plant at Littleton, a suburb of Denver. The town agreed to give him sufficient land if he would expend at least $110,000 on improvements. He posted a $10,000 bond as a guaranty. He more than made good, for by the time the plant was occupied in 1903 it had cost approximately $150,000.

In 1904 the company was awarded a grand prize at the St. Louis Exposition by the International Jury of Awards for its air drills, compressors, and hoisting machinery. That was excellent advertising. Leyner machinery became familiar to mining men the world over, and the name persists to some extent today. In many mining areas workmen still designate as a "Water Leyner" any drill of the type made popular by Leyner.

In 1905 a new model drifter drill—the Leyner Rock Terrier—was introduced. It was the lightest drifter drill on the market, weighing 54 pounds when equipped for dry drilling and 56 pounds when used for wet drilling. It differed from the other Leyner drills in that it was a valveless machine and rotation of the drill steel was effected by gearing the chuck to the feed screw. It became very popular for all light drilling work, and particularly for stoping. In the same year Leyner filed a patent application covering another drilling machine that differed radically from existing designs. It had two cylinders at an angle to each other and to the center line of the steel, and it was of the valveless type with the pistons opposed. A few of these drills were made, but timing

trouble was experienced with them and not many were sold.

In 1902 Leyner did some preliminary work on a drill-steel sharpener that convinced him that a much better machine than those then on the market might be developed. However, because of the construction of the new plant and other pressing business, he did nothing more at the time. He resumed work on his sharpener in 1907 and designed three sizes to cover a wide range of bit sizes. The type differed from present machines in that the clamping and striking head was located below the crosshead and rose to perform its operation. It was later found to have several disadvantages. The steel rested in a moving die, and that was objectionable. After short use the guide for the striking head had a tendency to wear sufficiently to allow considerable variation in the alignment of the dies, with the result that the bits were badly formed.

Despite present-day objections to the design, Leyner's sharpener was much superior to any then available. One great advantage was that the striking head and holding vise was operated directly by air pressure and that a dolly was in contact with the hot metal only a very short time. Three sizes were made: Nos. 1, 2, and 3. From 1907, when it was introduced, until 1912, some 400 sharpeners of this type were sold. For a time the Leyner Company disposed of more machines than all the other sharpener manufacturers combined. During one period the ratio was a high as 10 to 1.

In 1911 the company brought out the No. 5 Sharpener. It had a movable crosshead and improved dies. By means of two rods, one at each end, the crosshead was attached directly to the piston. This machine, on which Leyner received a patent on November 11, 1913, proved to be even more popular than the earlier ones. About this time the steel mills developed a process for rolling hollow steel which necessitated a device for keeping the hole open and uniform. Previously, punching of the hole had always been done by hand, and difficulty had been encountered in removing the pin. The No. 5 was therefore equipped with a shank-and-bit punch that included a pin-pulling device. A new type of hammer cylinder was adopted that had a feed-screw adjustment which permitted the use of a greater variety of dollies.

Leyner continued to turn out new models of his drifter drills from time to time, and in 1910 was offering Nos. 7, 8, and 9 to the trade. They were all similar in design and differed only in weight. He had also developed a line of stoping drills for which there was a good demand in the mining inindustry. The Leyner drills of that day would not, of course, compare favorably with corresponding types built today, but then they were the most efficient units obtainable and represented a distinct advance over the piston-type drills.

In 1912 the Leyner Company entered into an agreement with Ingersoll-Rand Company whereby the latter became the sole distributor of Leyner products and was granted the exclusive right to build rock drills under Leyner's patents. Under the terms of the contract Leyner discontinued making drills and compressors and devoted his plant to the manufacture of

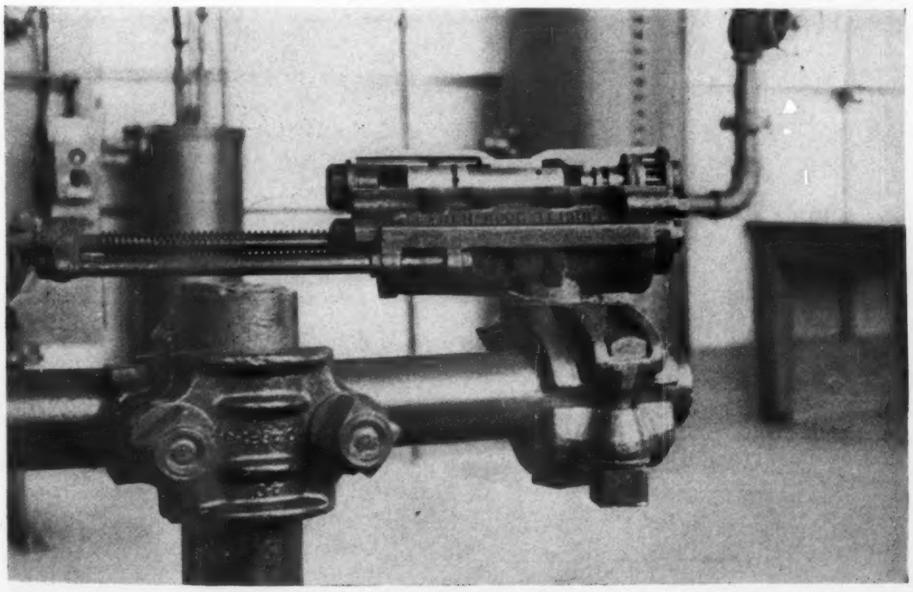
THE LEYNER TRADE MARK

drill-steel sharpeners, oil furnaces, and small hoists.

Utilizing the patents thus acquired, Ingersoll-Rand, in 1913, brought out the first hand-held Jackhamer drill, the forerunner of a line of machines that became universally popular and that remains so today. The advent of this type of drill created a demand for a small sharpener to recondition the drill steels used in connection with it. The Leyner Company accordingly developed a new sharpener, which was designated the IR-33. This unit differed somewhat from the No. 5. Instead of having a rod at each end of the crosshead, the latter member was attached to the center of the piston by a single large-diameter rod. The dies were placed as close as possible to this rod to eliminate the effect of overhang, an arrangement which was of advantage in that it permitted the operator to observe his work more clearly. This sharpener proved to be a very quick-acting machine, and met with approval from the start. It was therefore decided to use the same design for a larger unit, the IR-50, and that design has persisted in the case of all the models produced since then by the Leyner Company and its successor, the Ingersoll-Rand Company.

By 1915 Leyner's days of pioneering were over, although he continued to be active in the capacity of a consultant. Ingersoll-Rand engineers were doing most of the designing for the Leyner organization by that time. During the period from May 1919 to June, 1922, the latter concern was liquidated and reorganized under the name of Ingersoll-Rand Company.

On August 3, 1920, as Leyner was driving alone in his automobile on his way home from Denver, a team of horses drawing a farm wagon shied at an approaching train and jumped in front of the car as it was nearing the Leyner plant in Littleton. To avoid running into the horses, Leyner turned his car sharply into a ditch at the side of the road. The steering gear broke, and he was thrown heavily forward against the steering wheel, incurring fatal chest injuries. The accident occurred shortly after the plant had closed for the day, and some of the workmen rushed to Leyner's assistance. He was taken to his home, where he died two days later, on August 5, three weeks before attaining the age of 60 years.

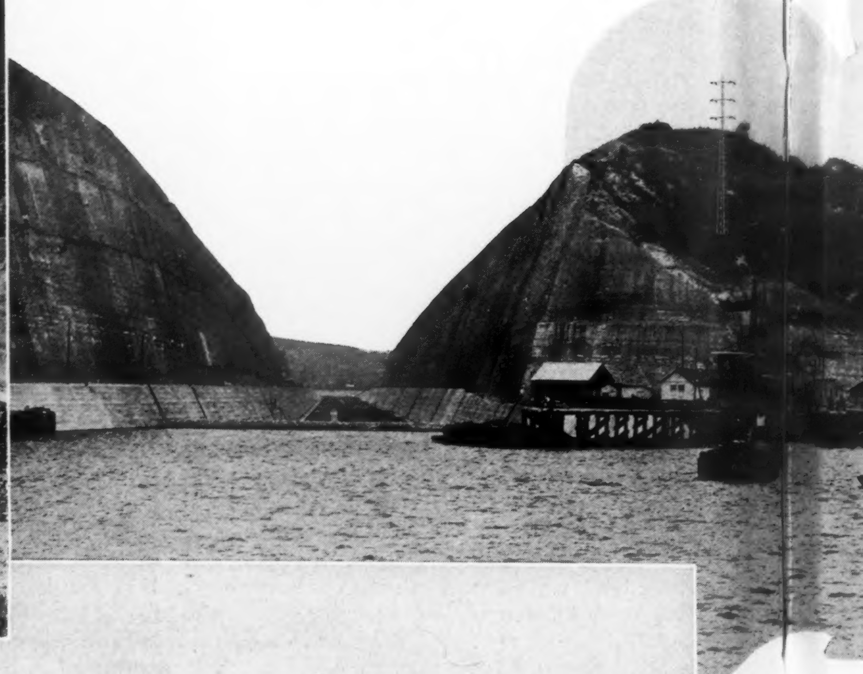


ROCK TERRIER DRILL

This light-weight Leyner drifter drill was introduced in 1905 and became popular for work in mines, particularly for stoping. It was a valveless machine and rotation of the drill steel was effected by gearing the chuck to the feed screw. It was the lightest drifter drill then available, weighing 54 pounds when equipped for dry drilling and 2 pounds more when used for wet drilling. Leyner drills always had cast-iron cylinders and steel pistons. The latter were fashioned from axles taken from old railroad cars.

Belgium's Albert Canal Nearing Completion

R. G. Skennett



THE Albert Canal, Belgium's newest, largest, and potentially her most important man-made water route, is now so far advanced that its completion will be celebrated during the first half of 1939. During the last eight years, occasional news items have reminded the world that work was continuing on that project; but to most of us it meant nothing more than another inland waterway in a country that has long utilized canals for low-cost transportation. The economic, industrial, and commercial significance of that engineering undertaking quite escaped us.

To say that the Albert Canal will provide an ampler and a shorter link between Liege—Belgium's industrial capital—and Antwerp—the nation's preëminent seaport—still leaves much to be told, especially when we are reminded that the route will represent an outlay totaling something like $500,000,000. Why should Belgium spend so much money on a new canal instead of enlarging the existing system that has been in service for nearly 80 years? The answer is that she has outgrown her old canals—the industrial and economic development of the country has long demanded this improvement. Finally, the new waterway is designed as an added means of national defense.

Liege is located in the upper section of the Meuse River Valley and deep in the eastern hinterland of Belgium where neighboring deposits of coal have led to the upbuilding of plants and factories famous

DITCHING ON A LARGE SCALE

In order to traverse the high ground between the Geer and Meuse river valleys it was necessary to make cuts that ranged as deep as 210 feet. Several of these sections are shown here. For the most part, the underlying material is tufa, a soft sedimentary rock that stands up well, leaving steeply sloping banks. The view at the top, right, shows the junction at Petit-Lanaye of the new and old canals, with the locks of the latter at the right.

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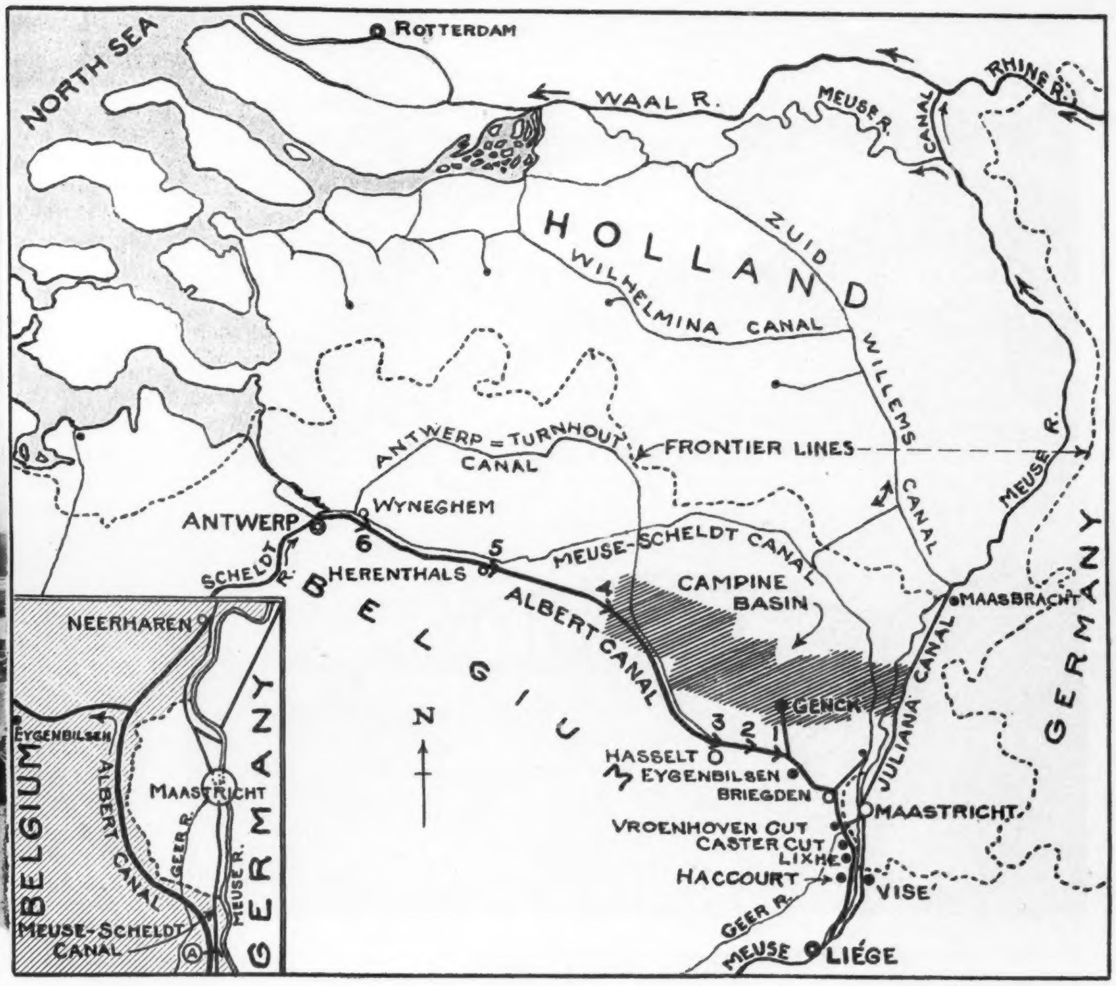
All Photos, International Mercantile Marine Company



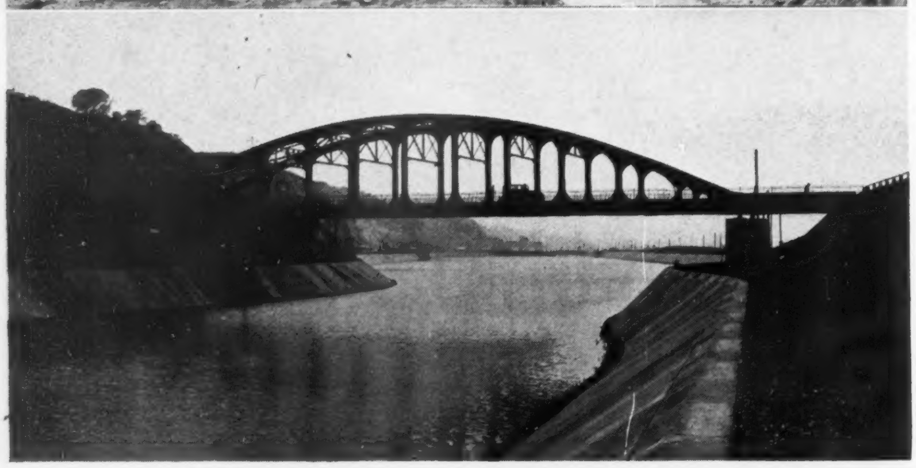
MAP OF CANAL

The new Albert Canal, which is being built at a cost of $500,000,000, will shorten the water route between Liege and Antwerp by 18.6 miles and boats will be required to pass through only six locks, as compared with 23 at present. The new waterway will be entirely on Belgian soil, whereas the existing one swings east into Holland at Maastricht to avoid high ground. Although Antwerp is the nearest seaport, 70 per cent of the water-borne freight originating in the upper Meuse valley has been exported through Rotterdam because the connecting canal system can accommodate larger boats. To meet that competition, the Albert Canal is being constructed to handle boats of 1,350 tons capacity. The cross-hatched area is the Campine Basin. The exploitation of its coal deposits is resulting in a flourishing industrial development that will be aided by the proximity of the canal. The figures along the canal route indicate the locations of the locks. The inset shows the region around Maastricht, where eight locks and four custom houses impede the progress of traffic using the present canal. The letter *A* designates the site of a lock that will permit transferring boats between the new and old canal systems.

for their iron and steel products. The city is noted for its ordnance works equipped to turn out small arms, big guns, and munitions of all kinds. Furthermore, in the valley upstream there are large enterprises engaged in the construction of locomotives and other machinery of diversified sorts. Liege occupies a strategic position on the Meuse in relation to the region above it, extending into eastern France where manufacturing is intensively carried on because of available resources of iron and coal. Moreover, the upper reaches of the stream are connected with industrially active sections of the Rhine through an interlinking canal that traverses adjoining parts of France and Germany. Now look at the map that accompanies this article.

Down to Liege is moved on the upper Meuse and certain of its tributaries a great tonnage consisting of raw materials and the output of the heavy industries along those waterways. Assuming that a considerable volume of this freight is destined for export and is seeking an outlet to the sea either via Antwerp or Rotterdam, all the boats so engaged journey from Liege to Maastricht, about 19 miles farther downstream, and from that point either continue northward to Rotterdam or turn westward to Antwerp. In the latter case, the old canal system has not permitted the passage of vessels of more than 450 tons capacity, while the middle and lower Meuse and some of the connecting canals extending northward through Holland are wide and deep enough to accommodate craft of 1,350 and even 2,000 tons capacity. As a consequence, cargo originating at Liege, or in the territory above it, and intended for export could be carried to Antwerp only at a disadvantage. Therefore, according to a report made by the American commercial attaché at Brussels but two years ago, the Port of Antwerp handled only about 30 per cent of the total volume of this traffic, as compared with 70 per cent registered at the Dutch port of Rotterdam. This was the case even though the maritime tonnage of Antwerp annually exceeded that of Rotterdam. One purpose of the Albert Canal is to alter this flow by offering facilities that will make Antwerp the logical *entrepôt* for a greater volume of the commodities moving from the Belgian hinterland to the sea and from the sea back into that region, with Liege as its focal point. And now let us see why, to accomplish this change, it has been necessary to construct a new canal instead of modernizing the available routes.

Maastricht is in Holland; and no matter whether boats traveling between that city and Liege use the canal that parallels the west bank of the Meuse or make their way on the virtually canalized river when the stages of that stream are favorable they have to pass through Maastricht. This imposes hampering conditions upon shipping. Within a stretch of 5¼ miles, the international boundary between Holland



BRIDGES OVER THE CANAL

Two graceful structures, one of reinforced concrete and the other of steel, that cross the inland waterway. All overhead crossings have sufficient elevation to provide clearance for any boats that may use the canal. Just beyond the bridge shown in the lower view the canal widens out into an expansive basin that affords room for many boats. With the exception of the three drawbridges at Antwerp, the Albert Canal is spanned by fixed structures.

and Belgium swings through an arc to the westward of Maastricht, and that much used bottleneck area bristles with difficulties that delay the progress of canal boats. Sharp turns have to be made at the foot of old fortifications; numerous swing bridges have to be opened and closed; tunnels must be threaded; three locks have to be negotiated in advancing in either direction; there are wharves along the narrow canal that hamper free movement; and, finally, there are four customhouses—Dutch and Belgian—at each of which inspection formalities have to be carriedout. It is said that the passage through Maastricht may take anywhere from three to eight days!

With the situation at Maastricht in mind, an eminent Belgian statesman once remarked: "It is dangerous for Belgium to confide the key of her house to any of her neighbors." This would be emphasized if war threatened and military supplies had to be sent by way of Maastricht to Belgian forts and troops. Accordingly, the Albert Canal traces a course that is entirely within Belgian territory: it completely disposes of the restrictions just enumerated and, in addition, has a number of other outstanding advantages.

By the long-existing water route between Liege and Antwerp, a distance of 96.3 miles, a vessel has to pass through 23 locks. The corresponding run on the Albert Canal is about 77.7 miles; but that difference in actual distance does not represent the whole saving. According to engineering estimates, it takes as much time to work through any one of the old locks as it does to cover a free stretch of 3.1 miles. Therefore, on the basis of elapsed time, the 23 locks increase the distance by 71.3 miles and make the time-transit length equal to 167.6 miles. Making the same allowance in the case of the six locks on the new canal—taking no account of their improved facilities for filling and discharging, the new waterway has a time-transit length of 96.27 miles, or is 71.33 miles shorter than the only course heretofore available between Liege and Antwerp. The competing route between Liege and Rotterdam is 141 miles long; but, counting the delays at the locks, the time-transit distance is 228 miles, or 132 miles more than that of the Albert Canal. Aside from offering an effective short cut, the latter, because of its depth and width, can be used by the largest canal boats that ply on the Dutch canals leading to and from Rotterdam. It has been so proportioned that vessels of 1,350 tons can be accommodated and travel at full speed between locks without setting up reactions that would endanger the sloping banks of the waterway.

The six locks of the Albert Canal are massive concrete structures and built so that they can be used by the big 2,000-ton barges that are operated on the Rhine and which penetrate the Meuse as far as Maastricht. Each consists of a group of three locks: two large ones of identical dimensions and a lesser one. Each big lock can take in either a single 2,000-ton boat or four 600-ton boats, two abreast, while the smaller one is intended for the economical handling of 600-ton boats, one at a time, of which many are in service. Each big lock has a length of 446.2 feet, a width of 52.45 feet, and a depth over the sills of 13.12 feet. The lesser lock is 180.44 feet long, 24.60 feet wide, and has the same depth over the sills as the large locks. All were designed after much experimenting with working models, and from an engineering point of view are of much interest. They have been planned so that vessels can be passed through them quickly; and the admission and discharge of water into and from the lock chambers is ingeniously controlled and stilled so as not to set up troublesome disturbances in them.

The success of the Albert Canal depends, obviously, upon an abundant supply of water at all times. This should be a matter of course; but such has not been the condition under which the old canal between the Meuse and Antwerp has been operated. The supply is admitted to the latter at Maastricht, and therefore in Dutch territory, in accordance with a treaty made between Belgium and Holland in the first half of 1863. The volume allowed to enter the canal at the Dutch intake varies with the level of the Meuse, the maximum being 353.14 cubic feet per second and the minimum 211.89 cubic feet per second—the latter period extending from the third week in June to the end of the second week in October. Even so, in operating some of its locks, the Belgian canal has discharged back into Holland an average of 61.8 cubic feet per second, and this at a point only 28 miles to the north and west of Maastricht.

The Albert Canal, on the other hand, taps the Meuse River in Belgian territory, and at the new Ile Monsin control locks just below Liege. This arrangement frees it from foreign regulation, assures it an ample volume of water at all seasons, and makes it possible for Belgium to deliver needful water to the Campine Basin for further industrial development and for irrigating its sandy soil, thus rendering that area valuable for agricultural purposes. The coal measures in the vicinity of Liege as well as those in eastern France along the

headwaters of the Meuse system are largely worked out; but, by offering low-cost transportation, the Albert Canal will make readily accessible the coal deposits of the Campine. That basin is therefore bound to become increasingly beneficial to Liege and to all the heavy industries that have long been established in the upper valley of the Meuse. These facts make it more understandable why Belgium is warranted in spending millions of dollars in building and equipping the Albert Canal.

The old control locks at Ile Monsin have for years served to create a navigable pool in the Meuse extending for a distance of 10.5 miles above Liege. Between the Ile Monsin locks and Maastricht, the old canal has five drops to reach the river level just above the latter city—that is, the canal descends from an elevation of 196.85 feet to one that is nearly 23.79 feet lower. To pass through Maastricht on this run, boats have to be put through three other locks before turning westward toward Antwerp. To avoid transit through the eight locks, to keep entirely clear of Maastricht and its traffic congestion, and to follow a course wholly within Belgium, the engineers had to settle upon a route that traverses the broken plateau country flanking the Meuse on the west where the highest of the ridges rises to an elevation of 377.3 feet, continuing thence in the basin of the Scheldt, an expanse of fairly flat country, to Antwerp. The major problem was to carry the canal across this plateau region to the north and west of Liege where, for a stretch of about 6.25 miles, nature presented many difficulties—some of them not fully realized until the gigantic task was first attacked in 1930.

THIS PLANT WAS MOVED

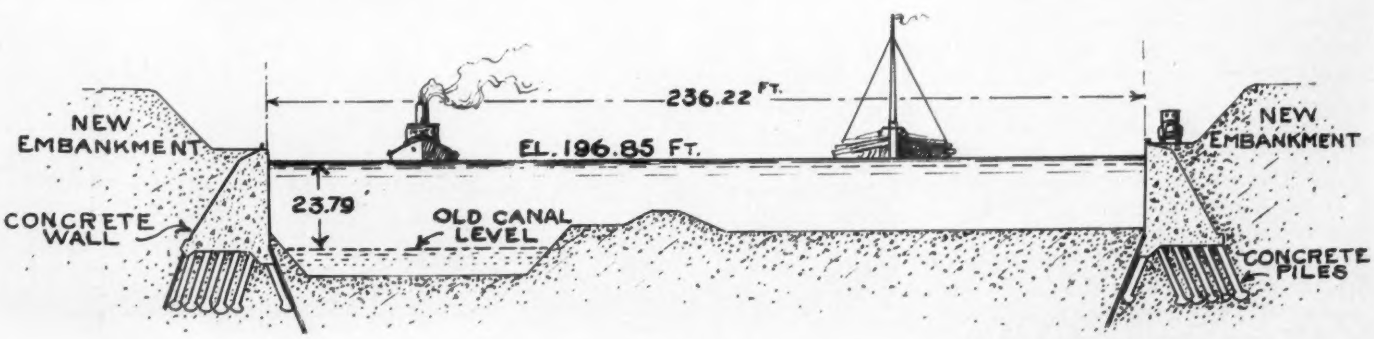
A cement mill at Lixhe was in the direct path of the canal, so it was re-established alongside the waterway.

The prerequisites were that the new canal should get out of the Meuse Valley and into the watershed of the Scheldt without any dividing reach—intermediate high point, and that water admitted at Liege through the new Ile Monsin locks should flow by a succession of drops, as few as possible, to the discharge point at Antwerp. The engineers found that this requirement could be met by locating the canal high enough so that the established level of the water at Liege could be maintained thence northward to the first succeeding lock near Genck in the Campine coal fields and some 20-odd miles distant. Accomplishment has meant the digging of three deep cuts—the deepest about 210 feet; and the work has entailed the excavation and disposal of 31,389,600 cubic yards of material of which about 50 per cent has been tufa, a sedimentary rock. Much of this spoil has been utilized in the upbuilding of embankments along adjacent sections of the canal.

Near Lixhe the canal crosses the Geer River—a tributary of the Meuse—which underruns the canal through a massive reinforced-concrete syphon; and in the same vicinity the new water route is superposed upon a stretch of the old Liege-Maastricht Canal. To confine and to sustain the broader and deeper Albert Canal at this point there are flanking walls of reinforced-concrete that virtually create an aqueduct with a water level nearly 24 feet higher than that of the superseded canal. On one side of the waterway the wall is about 5,906 feet long: on the opposite side it has a length of 1,970 feet. The two walls are underpinned by large and deeply penetrating reinforced-concrete Franki piles, formed *in situ* and forced down to their seatings. All told, 4,300 of these "elephant-footed" piles were used for this purpose.

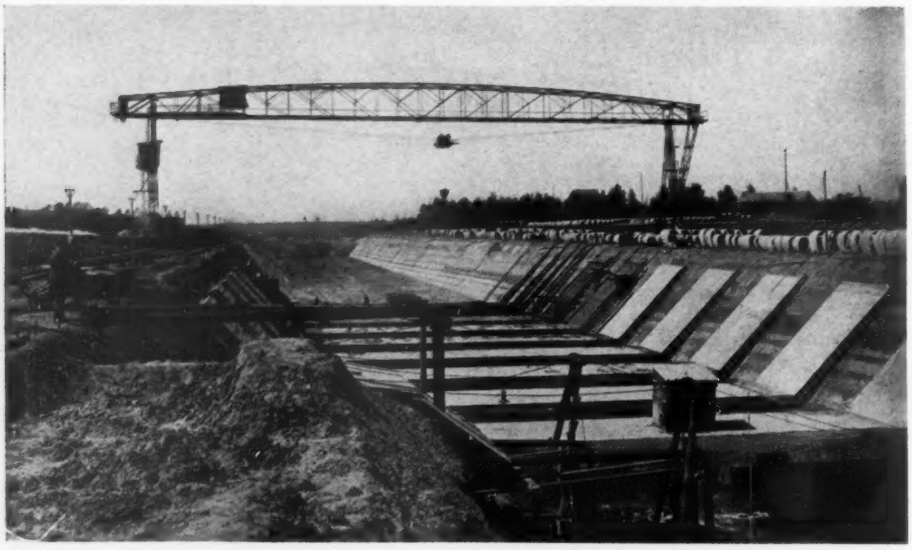
On the east bank of the canal in the Meuse Valley, for a distance of 3.1 miles, the tamped embankments of the water route necessitated the handling of more than 7,847,000 cubic yards of earth. In fact, to support the reinforced-concrete retaining walls and otherwise to confine the canal and to render the man-made slopes watertight, the contractors transported and placed in excess of 19,618,000 cubic yards. This material was spoil from the Caster Cut and the Vroenhoven Cut in the Geer and the Meuse valleys, respectively. The Caster Cut is for the most part through tufa and has flanking walls that are more nearly perpendicular for the reason that that rock has sufficient stability. The Vroenhoven Cut, however, is about equally through gravel, clay, and tufa, necessitating walls of a greater slope. The top of this cut has a maximum width of 650 feet.

The final cut in crossing the ridge between the Meuse and the Scheldt Basin was made near the Village of Eygenbilsen. It is a trifle less than 100 feet deep at that point, and presented difficulties that were increased by the unstable nature of the subsoil which, because of the water carried by it, tended to heave and to move in upon the excavation. It is said that even when the ground was dry it reacted like a mattress laid on springs whenever a moving



SUPERPOSED SECTION

Near Haccourt the new canal follows the line of the old one for a distance of several thousand feet but at a water level 24 feet higher. In this section it was necessary to build massive concrete retaining walls on each side and to backfill them with earth. The walls are supported on "elephant-footed" concrete Franki piles of which 4,300 were placed. Nearly 8,000,000 cubic yards of earth was deposited and tamped to form the east embankments. Exclusive of this section and the deep cuts, the canal has a bottom width of 85.3 feet, a channel depth of 16.4 feet, and a side depth of 11.48 feet.



PLACING CONCRETE LINING

Lining the bed and sides of the canal with interconnecting massive slabs of concrete in a section adjacent to the Eygenbilsen Cut. This section was built through water-bearing ground, and in order to stabilize it the flanking slopes of the canal were drained with reinforced-concrete pipes of which segments are visible at the right. The piping is elliptical in cross section.

load passed over it. The transportation problem was largely offset by employing American tractors which pulled scrapers and trucks, the latter being loaded by means of portable belt conveyors. The banks and bottom of the Eygenbilsen Cut were surfaced with heavy slabs of reinforced concrete cast in sections; and the ground directly back of the flanking slopes was drained by buried reinforced-concrete culverts, elliptical in cross section and of considerable capacity. In this manner the successive strata of sand, clay, and lower sand were stabilized and successfully dealt with despite the seeming impossibility of the task at the outset.

American power shovels and draglines bore the brunt in carrying forward the immense volume of excavating that had to be done at the three outstanding cuts. Furthermore, American portable compressors were used to advantage in many places in drilling rock, tamping, and helping to expedite various phases of this manysided undertaking. Time was the essence of all the contracts; and the construction organizations drew freely from any source that could provide equipment that would lighten labor and hasten the completion of the waterway. The project has given employment to 10,000 men in the field and to many other thousands in shops, factories, and contributive enterprises.

Where boats moving from Liege to Antwerp had to pass through eight locks on the run to and through Maastricht, they can now travel without a halt for a distance of 23.59 miles before reaching Lock No. 1 beyond the Eygenbilsen Cut. In fact, without a change in water level, there is now available a clear run from 10.5 miles above Liege to the lock just mentioned, and this vessels can cover at good speed whether they are self-propelled or under tow. It is estimated that when the Albert Canal is in service in its entirety it will be capable of handling 15,000,000 tons of traffic annually, or several times more than the old canal system between Liege and Antwerp has carried at its peak.

Five of the six locks on the Albert Canal provide for a water-level change at each point of 32.8 feet. At Lock No. 6, at Wyneghem, the change is 18.7 feet because the level of the basin at nearby Antwerp is 13.12 feet above the sea and is maintained so independently of the tidal stage in the contiguous Scheldt. At every group of locks there is a maneuvering basin to facilitate putting boats in position to enter or to leave them without interfering with other vessels. To be exact, there is a seventh or supplementary group of locks on the Albert Canal. This is upstream of Maastricht and at a point just before the canal swings away westward from the Meuse. It plays no part in maintaining the level of that waterway, but is designed to accommodate boats moving to and from Liege on the run between that city and Maastricht. This connection will make it possible for vessels plying on the canalized Meuse to the north of Maastricht and bound either for Rotterdam or for some point on the Rhine to use those routes if they desire. This link will give additional value to the Albert Canal.

Exclusive of the deep cuts mentioned, the canal has a bottom width of 85.3 feet, a channel depth of 16.4 feet, and a depth of 11.48 feet at the sides. The width where it submerges the old canal is a little more than 236 feet. Except at Antwerp, where it is spanned by three drawbridges, all the other crossings are fixed structures and of ample height to afford a clearance for any boats that are likely to use the new waterway. This arrangement differs radically from that prevailing along the old route.

The Government of Belgium and the responsible engineering and traffic experts consider the Albert Canal indispensable to the development and the economical utilization of the Campine coal fields, as well as to the heavy industries that will inevitably come into being within that favored region. The undertaking has been pushed steadily toward completion both as a well-considered aid to unemployment and as a lasting benefit to the nation.

Valuable information for this article was kindly furnished by Pieux Franki, Liege, Belgium.

ONE OF THE LOCKS

This lock at Petit-Lanaye connects the new canal with the Liege-Maastricht Canal. Each of the locks on the Albert Canal, six in number, is really three locks in one. Two large compartments will each handle one 2,000-ton boat or four 600-ton vessels, while a smaller one will handle a 600-ton boat. The admission and discharge of water into the lock chambers is controlled to prevent troublesome disturbances.

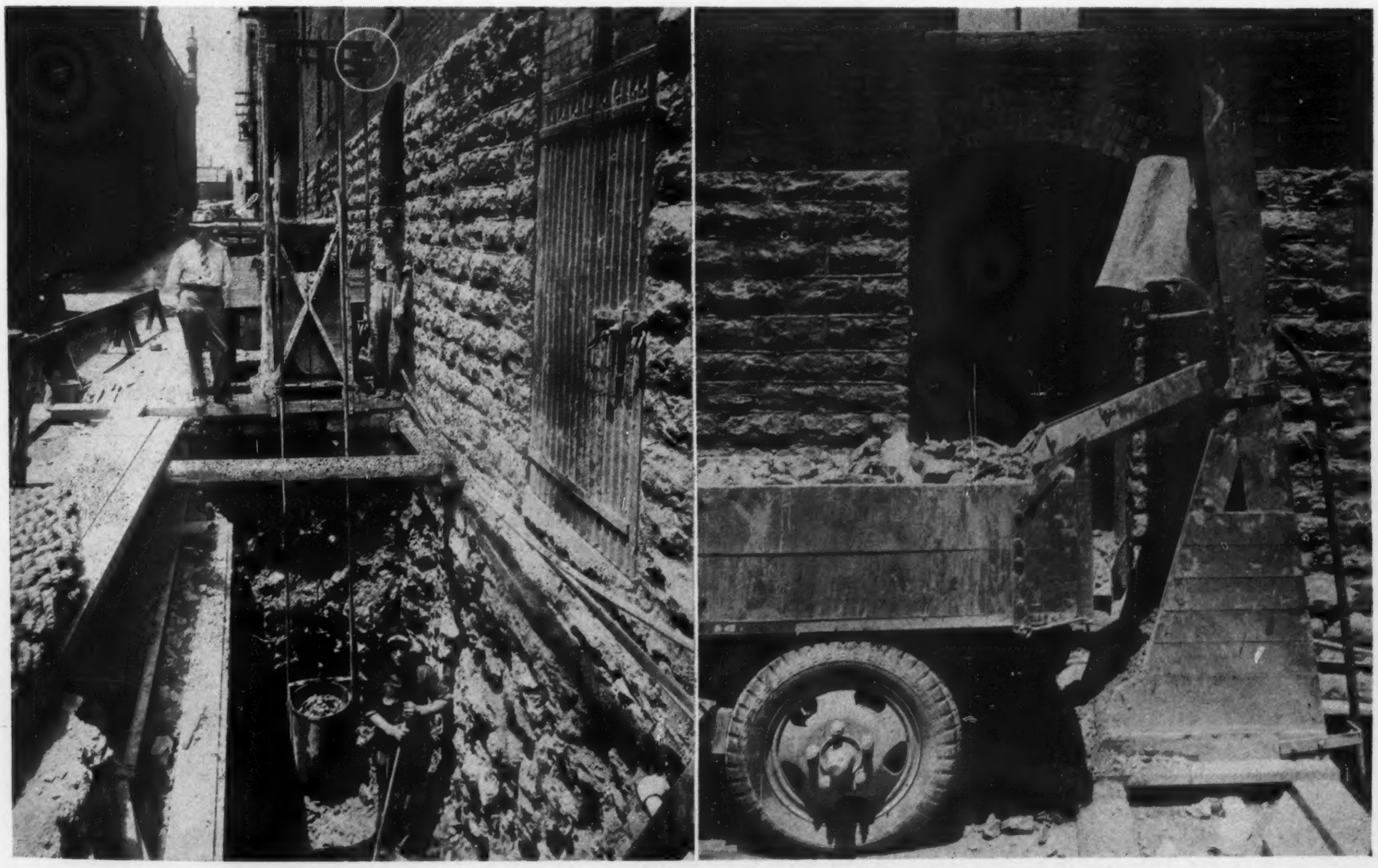
Air Hoist Aids Street Excavators

IT HAS been said that a good construction man must be at least part inventor. A. M. Riseman, superintendent of underground construction for the Tennessee Electric Power Company at Nashville, Tenn., fully meets this specification. On his present work of putting Nashville's overhead power lines underground he has developed two new devices that are helping his crews to maintain their schedule while working on busy downtown streets.

Under such congested conditions it is naturally essential that equipment take up as little space as possible in order that there may be a minimum of interference with traffic. To overcome the difficulties, Mr. Riseman has designed and built a compact air-operated hoisting apparatus for the removal of rock and earth from the excavations. The hoist is some 9 feet high, but it takes up a ground area measuring only 2x3 feet. Two wooden uprights constitute the framework. On top and at one side of this frame is mounted an Ingersoll-Rand BBS reversible air motor. This drives a shaft that extends across the space between the uprights and serves as a drum, the hoisting cable winding directly on it. Runners made of ordinary iron pipe reach about half way up the frame and as far down into the excavation as required, and these act as guides for an iron bucket that is elevated and lowered by the air motor. The bucket it loaded by hand in the confined manholes and then raised to the top where, by an ingenious arrangement of the pipe runners, it is caused to empty its contents completely and cleanly into dump carts. The hoist has proved very effective in speeding up the handling of spoil where limited working space prohibits the use of large excavating machinery of conventional design.

Mr. Riseman's other mechanical aid operates in conjunction with the hoist. It is a dump wagon that is pulled behind an ordinary 1½-ton truck and is so balanced that it can be easily moved by hand and spotted beneath the chute of the hoist. Virtually all the other mechanical equipment on the job is air operated. Three S-49 Jackhamers, three CC-45 paving breakers, and numerous chipping hammers, clay diggers, etc., are used to excavate the transformer pits and manholes. In the downtown areas, a 285-cfm. Motorcompressor supplies air for the operations, while a smaller I-R 2-stage, portable compressor serves in outlying locations.

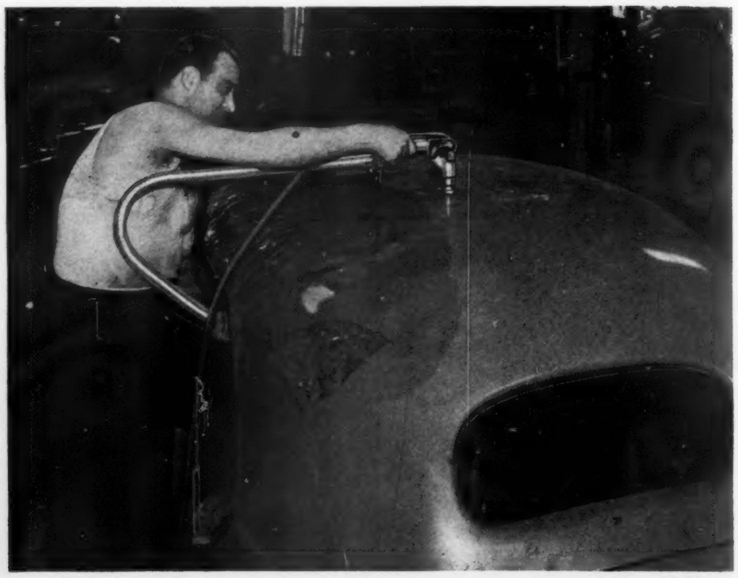
The undertaking is part of a program of civic development in progress in Nashville. In addition to the removal of all overhead power lines and their installation underground, it involves increasing the voltage from 2,300 to 13,000. Up to date, 35 manholes and eighteen transformer vaults have been completed and 25,000 feet of primary cable and more than 100,000 feet of secondary cable have been placed. The project was started about 2½ years ago, and is continuing at a rapid rate despite the difficulties encountered in the business section. Needless to say, the compact hoist and the easily maneuverable dump carts have helped greatly to expedite the operations. About 45 men are now engaged in the work, which is approximately half completed.

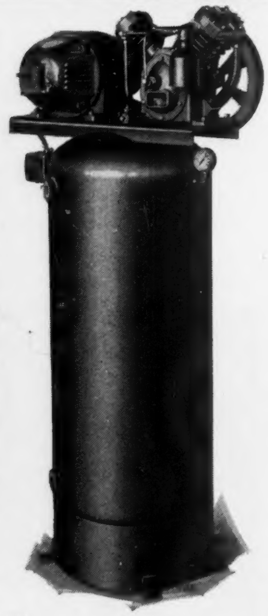


THE HOIST AND CART IN SERVICE

The left-hand picture shows construction details of the hoisting apparatus and illustrates how it works. The air motor at the top of the framework (in the circle) rotates a shaft that serves as a drum on which is wound the cable from which the bucket is suspended. A. M. Riseman, who designed and built the hoist and the dump cart used in connection with it, is standing at the left. The view at the right shows how the bucket automatically dumps its load into the cart. The latter is mounted on pneumatic tires to facilitate backing it into position by hand for loading.

Pneumatic Hammer for Auto Repair





PUTS BATTERED CARS IN SHAPE

The new fender and body straightener at work on different parts of cars showing the ease with which they can be reached and the hammer guided by means of the interchangeable yokes. At the top, right, the tool is repairing the crumpled top of a sedan for which purpose it is fitted with the turret-top yoke, which has the longest reach. In the other pictures it is used to re-form damaged fenders with the aid of the smallest yoke. The standard outfit consists of the hammer, four dollies, two upper dies, one wooden dolly holder, two yokes, and 50 feet of ¼-inch air hose with connections. A small-capacity compressor such as the Type 30 at the right is suitable for this work. The unit is mounted on a vertical air receiver to save space.

NO ONE likes dents in his car, whether it is old or new, and with the heavy traffic on our roads the chances are that every motorist sooner or later will have to take his automobile to the repair shop to have some part of it put back in shape. Usually, he is in a hurry, and yet he wants the job done so well that little if any trace of the damage remains. This has not always been easy in the past when the work was done altogether by hand hammering. But today, with an air-operated straightener designed especially for this work, dented and even badly crumpled turret tops, doors, panels, hoods, and fenders can be restored to their original form quickly and without stretching or cracking the metal or without leaving in it disfiguring humps or "waves."

A tool of this description has recently been made available by Ingersoll-Rand Company. It consists essentially of a cushioned, high-speed hammer, of a throttle valve and lever, of a power regulating valve, and of interchangeable yokes, dies, and dollies of different shapes and sizes to meet service requirements. The yokes have a reach of 14½, 23, and 33 inches, respectively, which is sufficient for all ordinary needs. The largest one, which is not included in the standard equipment, is for turret-top use.

With the assembled tool in working position, the operator presses the throttle lever down by hand, as shown in the accompanying illustrations. This automatically clamps the assembly securely in place and actuates the valve that controls the air supply. Conversely, when the lever is released, the hammer stops and the jaws of the yoke open—the gap in all cases being wide enough to permit shifting or removing the straightener with facility. The dollies and dies are designed to conform to the contours of modern automobiles. Four dollies are furnished with each tool, and these are adequate for re-forming flat surfaces, corners, and sharp, medium, or slight curves.

The force of the hammer blows depends upon the air pressure. This is raised or lowered, according to whether heavy or light work is to be done, by a regulator built into the tool. By means of it, air at 150 to 180 pounds pressure commonly used in a repair shop can be reduced to 90-100 pounds without the installation of a separate reducing valve. With compressed air at 90 pounds pressure per square inch, the straightener, which is known as Size 77, can deliver 7,500 blows a minute. Air consumption is low, and for that reason a 1½-hp. compressor is suitable for the purpose. It should be added that this new fender and body straightener is designated by the manufacturer as a finishing tool which, unless the damages are minor ones, is to be used for "ironing out" surface irregularities remaining in the sheet-metal parts of an automobile after they have been restored as nearly as possible to their original form by the customary hand method.

Driving Pipe Underneath a Highway

USING an air-operated pile driver, a contractor recently drove two 2½-inch cast-iron water pipes underneath a 30-foot-wide concrete highway east of Phillipsburg, N. J., in approximately half an hour of actual driving time. Where the work was done, a new and wider highway is under construction, and it was necessary to relocate and to re-lay water pipes on one side of the existing roadway. To avoid interfering with traffic, officials of the highway department ruled against breaking the concrete pavement or tunneling beneath it, so the contractor resorted to the aforementioned method. A saving in time and money was the gratifying result.

A narrow trench about 5 feet deep and a little more than 20 feet long was dug on one side of the roadway and at right angles to it. A 20-foot length of pipe was laid in it and then forced into the supporting earth embankment by means of an Ingersoll-Rand R-30 paving breaker that was fitted with a pile-driving attachment. To facilitate the latter operation, a hardened-steel, conical-shaped point with a 45° taper and deep threads was screwed on to the penetrating end of the pipe. The driving end was similarly fitted with a heavy protecting cap. An ordinary pipe cap would not have been satisfactory because of the great amount of heat developed and the force of the pounding.

Operated with air supplied by an I-R two-stage, air-cooled, portable compressor, the pile driver drove this first 20-foot pipe length into the earth in about five minutes. The cap was then removed, another pipe section 15 feet long was coupled to the first one, and the work resumed. The lengthened pipe was driven the remaining distance of 15 feet through the embankment in about ten minutes, the total time for the 35-foot length accordingly being approximately fifteen minutes. The pipe end appeared on the far side at almost the exact spot indicated, the accuracy of the operation exceeding expectations.

A second pipe was then started at a point close to the first one. This also was made up of two sections, and the time of penetration was about 22 minutes, the additional seven minutes being required because the first pipe had naturally compressed the surrounding earth to some extent. It deviated from the desired line by about 3 inches vertically and the same distance horizontally.

It was found, by experimenting, that the pipe advanced best under a swift repetition of fairly light blows which served to keep it moving almost continually. The contractor expressed the belief that pipe could be satisfactorily driven twice the distance covered in this instance where great accuracy is not essential.

ECONOMICAL PIPE LAYING

The picture at the left shows a 20-foot length of pipe laid flat in a trench at one side of the highway and with an R-30 pile driver in position for driving it. Above are seen the ends of the two pipes where they broke through on the opposite side of the embankment. The steel point that facilitated penetration is still on one of the pipes.

Fuel Gas from Waste Sulphite Liquor

ONCE more the laboratory man has solved a problem of many years standing: what to do with the sulphite liquor after it has done its work of reducing wood to pulp in paper making. For every ton of cellulose fiber there are 10 tons of spent liquor, and as 1,500,000 tons of wood pulp are produced annually in the United States by the sulphite process, the amount of waste liquor to be disposed of reaches large proportions. As it is not fit for re-use, it has been the practice to dump it into the waterways on which the mills are situated; but, with the expansion of the industry, that method has been more and more frowned upon because the sulphurous acid in the liquid not only contaminates the waters but also poisons the fish and destroys plant life growing along the banks.

The sulphite process was introduced in 1867, and for many years since then efforts have been made to find a practical solution of the problem, but without much success. It remained for Doctors H. K. Benson and A. M. Partansky of the University of Washington, Seattle, Wash., to add another important chapter to the story relating to the commercial utilization of industrial waste materials and thus to end a nuisance that threatened to have serious consequences.

Several years ago the Puget Sound pulpwood industry sought the aid of the two scientists. As a preliminary step they studied the various proposals and attempts that had been made in the past to convert the sulphite liquor into useful products or to render it harmless so that it could be safely discharged into streams. They found, among other things, that it was being used in Europe as a binder in briquetting powdered fuel such as sawdust, peat, and coal and in making foundry sand cores. It was also being applied to roads to bind the dust. Satisfactory though these applications are, they did not promise an adequate outlet for the waste, and it was then that the investigators explored an entirely new field.

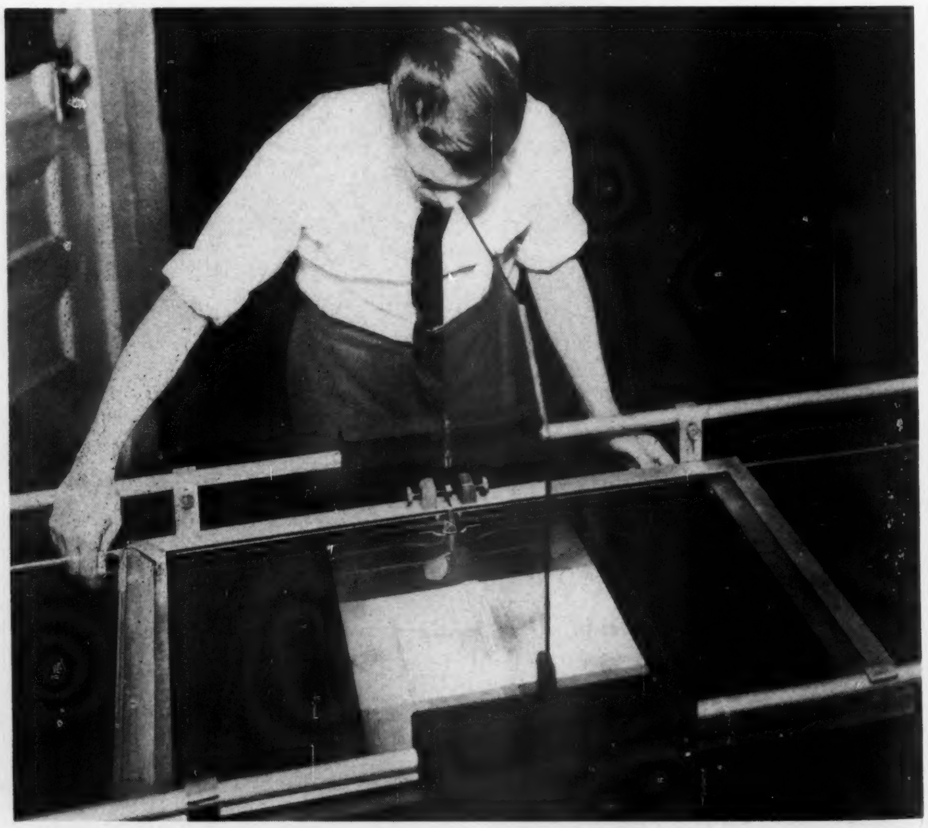
With the knowledge that anerobic—airless—bacteria cause cellulose in decaying swamp vegetation to ferment and thus to generate marsh or methane gas, Doctors Benson and Partansky, according to the *Scientific American*, reasoned that it would be possible by the aid of the same tiny bodies to produce methane from the organic material in the sulphite liquor. Obtaining a large number of gallon jars, they put into each 850 cubic centimeters—approximately 1½ pints—of the neutralized liquor and about 4 pounds of mud from marshlands where anerobic bacteria were known to be active. Except for an air space, each container was then filled with water and placed in a chamber under a temperature of almost 97°F. Daily records were kept of the amount of gas discharged from the tubes inserted in the containers, and at the end of nearly a year—340 days—it was found that each had given off in excess of 18,000 cubic centimeters of gas, or more than twenty times the volume of the original liquor. It contained 78 per cent of methane—the remaining 22 per cent consisting of carbon dioxide and hydrogen—and had a heating value equivalent to 400 pounds of coal. These figures, when applied to the industry as a whole, mean that the 15,000,000 tons of sulphite liquor that have to be disposed of in the United States annually can be made to yield fuel having a heating value equivalent to 300,000 tons of coal.

Without going into further details, it is authoritatively reported that the research work which has been done since the conclusion of these tests has resulted in the discovery of a process by which fermentation can be hastened and in the development of an engine capable of burning the gas—in short, that the experiments have reached a commercially practicable stage.

Three-Dimensional Pictures Help Metallurgist

THE modern method of examining metals for internal flaws prescribes the use not only of X-rays but also of a combination stereoscope and stereometer, as it is possible by their aid to obtain 3-dimensional pictures and to locate the defects with accuracy. In other words, where the X-ray alone produces a 2-dimensional picture that makes it difficult to determine the exact depth of a flaw in relation to the surface of the metal, the newer procedure not only reveals it but also indicates its distance from the surface.

Today, a block of steel, for example, is first X-rayed at an angle, and then it is again X-rayed from a point 5° away from the original set-up. The two in themselves flat pictures thus obtained are then viewed through the stereoscope which merges them into one image in which the defect is seen in its true relative position. Its actual depth is ascertained by means of the stereometer. This instrument has two wires, and as these are moved from side to side of the pictures their image appears to approach or to recede, depending upon the direction of the movement. When the position of that image coincides with the position of the flaw in the metal, then the distance of the flaw from the surface is registered on an associate scale. By these up-to-date facilities, the metallurgist has been able to reduce the error factor in determining depth from approximately ½ inch to a maximum of 1/16 inch.



DETECTING FLAWS IN STEEL

In the General Electric Works Laboratory, showing C. D. Moriarty using the combination stereoscope and stereometer in the 3-dimensional study of internal defects in steel.

ALUMINUM'S BIRTHDAY

THE fiftieth anniversary of the founding of the aluminum industry in the United States was observed on November 10 in New York City at a dinner given by the Aluminum Association, a trade organization composed of the nation's leading manufacturers of aluminum products. The guest of honor was Arthur V. Davis, chairman of the board of directors of the Aluminum Company of America. As a young man, Mr. Davis assisted Charles M. Hall with the experiments conducted in Pittsburgh in 1888 which led to the development of the electrolytic process for extracting aluminum from its ores. Strangely enough, P.T.L. Heroult accidentally hit upon the same process in France at about the same time.

Although aluminum is the third most plentiful element and makes up approximately 8 per cent of the earth's crust, it has such an affinity for oxygen that it is found nowhere in a free state. Until the discovery of the electrolytic process it could be isolated only by expensive chemical treatment of its ores. In 1884 it was selling in the United States for $1.10 an ounce, and was so little known that an aluminum cap made for the Washington Monument was exhibited in one of the show windows of Tiffany's world-renowned New York store. Four years later the metal was being offered in England for as low as $2.75 a pound. By 1891 the electrolytic extraction process had entirely supplanted chemical methods, and the price of aluminum was reduced to $1 a pound. Since then it has been progressively lowered, and for a number of years has fluctuated between 20 and 30 cents a pound. Considering that aluminum weighs only one-third as much as copper, it costs relatively less than the red metal.

By reason of its lightness, strength, ready workability, and resistance to corrosion, aluminum has gained widespread employment. It is estimated that the kitchens of the country contain more than 400,000,000 aluminum cooking utensils. Of late years its use as an engineering material has increased rapidly, and this field of application seems to offer unlimited possibilities.

The production of aluminum and its fabrication into useful forms affords employment for about 200,000 persons. Despite the many refinements that have been made in the extraction process, the reduction of the principal ore—bauxite—is still a rather complicated procedure. Nine tons of raw materials, 22,000 cubic feet of natural gas, and 24,000 kw. of electrical energy are required to produce a ton of the metal.

Hall's experiments half a century ago were carried on in a 1-story building in Pittsburgh. Today, 200 research workers in a $1,300,000 laboratory at nearby New Kensington are engaged in seeking more knowledge about aluminum and its alloys and to extend their utilization. To finance these efforts, the Aluminum Company of America expends about $750,000 annually. Leaders in the industry believe that they have as yet barely scratched the surface, and that during the next 50 years the uses of aluminum will be multiplied many fold.

SCOTTISH INDUSTRIAL CENTER

COMMUNITIES that are seeking new industries would do well to study the scheme being fostered by the British Government at Hillington, near Glasgow, Scotland. There, under the name of the Scottish Industrial Estate, an area of 320 acres of farmland in an attractive natural setting has been plotted for industrial development. Any approved manufacturing concern that will locate there will be provided with a factory built in accordance with its special requirements. It may occupy this plant on a lease basis, thereby being relieved of making any capital outlay. As the estate company is a nonprofit organization, rents are low.

To equip the factory with machinery and to obtain working capital, the tenant may borrow as much as $50,000 for a period of five years, the conditions of repayment and rate of interest charged depending on the apparent risk entailed. Moreover, he is entitled to receive contributions towards overhead expense, income taxes, etc., these grants being applied in the form of remissions up to 100 per cent of the outlays involved and extending over a period of not more than five years.

The primary purpose of this subsidizing scheme is to lessen unemployment. In the Glasgow area there are approximately 45,000 persons trained for work in various fields of industry who are jobless because of changes in world economic conditions. The Hillington estate is one of a number of "special areas" that have been singled out for assistance by the British Government.

Most of the factories being built on the estate have been planned in blocks of standard units, each containing 5,000 square feet of floor space. Smaller structures, each containing 1,200 square feet of floor space, are built in "nests" of seven. In both cases, the factories are of the most modern design and construction, affording ample daylight illumination, almost complete freedom from internal columns, and ease of adaptability to usual manufacturing practices. Steam for process work and heating will be furnished from one central plant, thereby reducing its cost and minimizing the smoke nuisance. Water, gas, and electricity will be supplied to all tenants by local utilities. There will be a central garage for all trucks. Roads serving both the front and rear of each building have been laid out to describe pleasing geometrical patterns. Unoccupied areas have been sodded and landscaped with flowers, trees, and shrubbery.

During the seventeen months that have elapsed since the movement was launched, 120 factory buildings have been completed or put under construction and tenants have been obtained for 80 of them. The Hillington venture is one of the means by which it is hoped that Glasgow, with a population of 2,000,000, will regain in full the measure of industrial prestige it enjoyed for 200 years, during which period it has been, successively, a center of the tobacco trade, of textile making, of shipbuilding, and of engineering construction.

ADD-A-BIN

This is a new type of cabinet for the innumerable small gadgets such as nails, screws, brads, gaskets, and fuses that are in everyday use in most factories and shops and that are usually kept in anything but an orderly fashion. The separate housings may be screwed to a wall, bench, or other suitable place for a permanent installation, or to one or both sides of a panel for a portable kit. Features claimed for this file system by the manufacturer, the Noggle Products Company, Ann Arbor, Mich., are that the separate bins are balanced so delicately that the weight of the contents, no matter how light, will cause each to close when the hand is removed; that they will lock in an open position when lifted slightly; that they will remain open horizontally when pulled out and down; and that they can be withdrawn entirely from their housings.

Again the Channel Tunnel

TO BUILD or not to build the Channel Tunnel? Once more the question has arisen, and this time the plan is to link France and England with a vehicular instead of a railroad tunnel to meet the needs of modern traffic. Mr. Andre Basdevant is the father of the present scheme, which involves the driving of two bores, 26 feet in diameter, from Sangatte, near Calais, to Shakespeare Cliff between Dover and Folkestone, a route laid out more than 60 years ago. The finished inside tunnel section is to have a height of 15 feet, and the road is to be 21 feet wide and flanked on each side by narrow footpaths for inspection purposes. The regular ventilating system will provide for the admission of fresh air through apertures in the floor and the discharge of vitiated air through openings in the roof, and this is to be supplemented by air conditioning at regular intervals and in sections of 656 feet each.

New "Trade Standards"

THE fifth edition of the publication *Trade Standards* has recently been issued by the Compressed Air Institute, a trade association composed of the principal American manufacturers of air and gas compressors, pneumatic tools, and rock drills. Since the fourth edition was published in 1930, the Institute has broadened its field of activity to include, in addition to compressors, various types of apparatus operated by compressed air. The new edition has been amplified accordingly, and in all other respects is a completely revised and up-to-date work. *Trade Standards* is a 101-page book in a flat-opening binding, and is well indexed. Section headings are: Definitions; Nomenclature and Terminology; Rating Standards, Guarantees, Trade Policies; Test Standards; Installation and Care of Compressors; Lubrication; Data, Tables, and Formulae; Uses of Compressed Air; Reciprocating Compressors and Vacuum Pumps; Rotary Displacement Compressors, Blowers, and Vacuum Pumps; Centrifugal Compressors and Blowers; Compressor Accessories—Receivers, Aftercoolers, Filters, Piping, Valves, and Fittings; Portable Compressors; Rock Drills and Accessories; Pneumatic Tools and Accessories. Price $1, and obtainable from the Institute, 90 West Street, New York, N. Y.

Chile Stakes Gold Panners

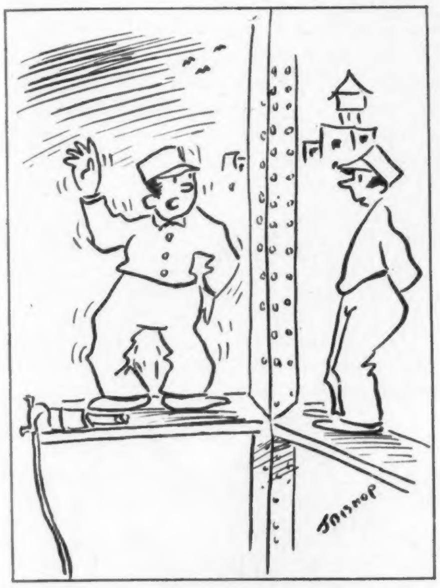
SINCE 1932, the Chilean Government has been conducting a Placer Gold Bureau primarily to reduce unemployment and, incidentally, to increase the production of that precious metal. A model town, complete with schools, playgrounds, etc., has been constructed at Andacollo, one of the country's principal placer-gold districts, and there anyone in need of work and shelter can find both. The practice is to assign to each man a definite place in which to pan for gold, the bureau providing him with the necessary tools and living quarters. In exceptional cases, small sums are advanced for food and other supplies. The gold is purchased by the bureau at Andacollo, payment being made over the counter any business day.

Just what the organization has accomplished is shown by the following figures taken from *Mineral Trade Notes*, a U. S. Bureau of Mines publication. The number of men thus kept gainfully employed since the bureau was established averaged 31,436—the peak—in 1933, with a total production of 1,932,226 grams of crude valued at 42,058,127 paper pesos, and 13,614 in 1937, with an output of 3,123,971 grams, the largest on record, worth 77,533,102 pesos. (One paper peso is equivalent to 3.75 cents in United States currency.) Although the unemployment problem in Chile is no longer acute, the Placer Gold Bureau will probably continue to function in view of its successful operation and the country's need for gold to obtain foreign exchange.

EXPEDITING FOUNDRY WORK

The making of large castings involves the building up of heavy flasks by bolting together flange plates and shapes. Side plates are built up of sections, making it possible to obtain any length desired. The shape of the casting determines how much bolting-up work is necessary; but a flask suitable for a 3-ton casting may call for the use of as many as ninety 1 or 1⅛-inch bolts. As the flasks have to be torn down and rebuilt for each different job, it is apparent that the aggregate amount of work of this kind in a foundry is large. The picture shows a flask being assembled with the aid of an Ingersoll-Rand Size 533 impact wrench, a tool that materially speeds the operation of applying as well as of removing nuts. This type of wrench, which has a wide field of application in many industries, is a recent pneumatic-tool development. Power is supplied by a multivane air motor, the torque of which is converted into rotary impacts which are transmitted to a chuck or socket that engages the nut. These impacts take place at the rate of from 1,100 to 1,700 per minute, depending upon the size of the tool, and exert a more powerful turning effect than it is possible to obtain with any other portable wrench.

—Air Jets—



Big Apple nothing! I've got a hot rivet in my pocket.

AIRY ARROGANCE

There is air of all descriptions,
Also air of various kinds;
There's the air we hum and whistle,
Likewise air the flier finds.

"Give him air," the doctor clamors
When the crowds start gath'ring round;
There's the air milady puts on
When society she's found.

Then you air your room or clothing
Or your theories, as it were;
The kitten in the rocker
Inhales air that it may purr.

We build our own air castles
And air rifles for the boys;
There are air lanes for the airplanes
Plus the air that propels toys.

"The air a solemn stillness holds,"
The poet Gray sets out—
And the air she gives her boy friend
Oftimes causes him to pout.

People air their family troubles
In divorce courts and the like,
When the most of all these cases
Should be held, perhaps, air tight.

And now that we have aired the air
By fits and starts and jumps,
We must make casual reference to
The Airedale and the pumps.

Londonderry air's unlike
The kind which grips the brakes,
Or hammers which respond to air
Of many kinds and makes.

We break the subject down to hoists
With valves and ducts and hose;
And air that's washed and purified
For those who seek repose.

And even drills and rooms air cooled
With sprays with air to force;
To say naught of the vacuum tank
Or blasts that cause remorse.

But now to sum the whole thing up
With air of all kinds stressed;
Let's take the hot variety, say,
And see that it's compressed.

—M. C. KLEYN

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UNDER-MINING OBSERVATIONS

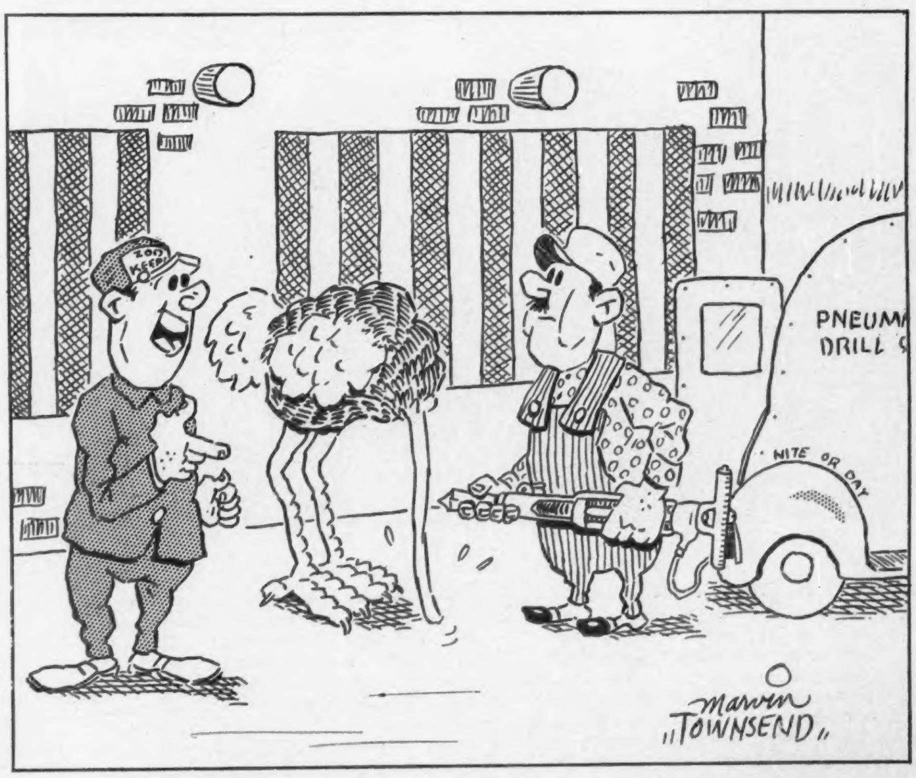
Geologists are gentlemen extremely erudite
Who scan the scripture of the stones,
And commentaries write:
In social gatherings and games
Their interest is fickle,
And may desert a Slam in Spades
To dally with mispickel.
They show not any great concern
Regarding "What to wear,"
But mildly tend to mellow hats
And overplus of hair.

A mining engineer's a man
Who frequently is sent
To overlook the underground
From an up-lifting bent:
He types voluminous reports
On values, trends and traces,
And shows affinity for shoes
Requiring lots of laces.

**Keep your finger out of them holes—
I thought it was a rivet.**

Prospectors are persons of dubious means
Who thrive upon bacon and bannock and beans:
When they land on the rocks, they pick up quite a lot,
Which at times lead to wealth—but more often do not.
Their pulses beat high with perpetual hope,
They amble untiring o'er valley and slope
And, summer or winter, in town or on trek,
Will not keep their shirts buttoned up at the neck.

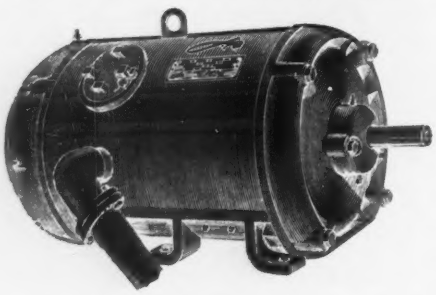
—GRAHAM HARRIS
in *Canadian Mining Journal*



You'll have to dig him out. He tried to hide in the fresh concrete.

Industrial Notes

The Louis Allis Company, which is said to have originated the first fan-cooled, explosionproof motor, has announced a complete new line of direct-current explosion-



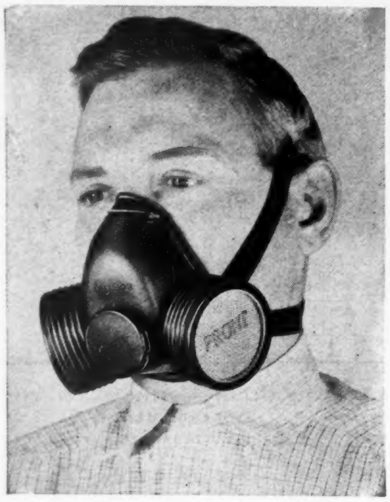
proof motors. They have been inspected and tested by the Bureau of Mines Laboratory and the Underwriters' Laboratories and approved for use in atmospheres containing explosive dust or gases. The motors are of compact, heavily reinforced cast-iron-and-steel construction, and incorporate, it is claimed, as many as eighteen improved features. These are described in detail in Bulletin No. 520, which can be obtained from the company, 427 E. Stewart Street, Milwaukee, Wis.

Prunings of fruit trees and forest slash, heretofore considered waste, can be made into high-grade paper, according to the *Canadian Engineer*. Three industrial chemists of Toronto, Ont., have developed a process by which it can be profitably turned into both coated and uncoated stock which has successfully undergone printing tests. Sufficient quantities of the raw material are said to be available to warrant the construction of large pulp and paper mills.

Interest centers in a mobile telephone exchange which is being developed in England. It is designed for emergency use primarily in rural districts when the regular exchange breaks down through one cause or another.

Sta-Put rock-drill oil is a product of E. F. Houghton & Company which, in a recent folder on the subject, claims that it is a lubricant that is suitable for use in connection with any type of oiler. It is available in 15-, 30-, and 55-gallon drums. Anyone interested can obtain the folder, entitled *Sta-Put Rock Drill Lubricants*, by writing to the company at Third and Somerset Streets, Philadelphia, Pa.

For plating operations, brazing, paint-spraying, and other similar applications, as well as for use where there are light concentrations of organic vapors or acid gases, Willson Products, Inc., has designed a chemical cartridge respirator that is said to offer an unusually large measure of protection. As the accompanying picture shows, it has two extra-large replaceable cartridges, an arrangement that results in very low breathing resistance. The rubber face piece is compact, conforms to the facial contours, and is made so as not to interfere with visibility. Spectacles or goggles, or a welder's helmet, can be worn with comfort. The Twin Cartridge Chemical Respirator, as it is designated, comes in two sizes—with a content of either 190 or 100 cubic centi-



meters; and there are available three separate chemical fills to meet a variety of service requirements. This particular type of respirator is not suitable for protection against carbon monoxide or atmospheres deficient in oxygen.

Oil from the kernel of the grape is finding increasing application in Germany where its production has increased from 10,567 gallons in 1937 to 52,855 gallons (estimated) in 1938. It is obtained either by pressing or extraction and varies in taste and color, depending on the process applied. It is suitable for edible purposes and is used in the manufacture of high-grade cosmetics and paint products.

In the manufacture of coated paper it is of importance that the coating material applied be of uniform thickness throughout. To insure this, up-to-date mills now use an air-brush coater consisting of an applicator roll, which deposits more than the required stock on the paper, and of a flat air jet or "blade" which takes off the excess and leaves an absolutely level coating of the desired weight.

Congress has under advisement a proposal by a commission of experts that the Government acquire and hold in reserve for use only in case of emergency certain minerals for which the United States depends mostly on foreign sources of supply. Chrome, manganese, tungsten, and tin are among those listed; and it is suggested that stocks of these be purchased amounting to 250,000 tons, 554,000 tons, 3,350 tons, and 85,000 tons, respectively.

CLOSING TUBES FOR SHIPPING RUGS

A Pacific Coast manufacturer of printed rugs ships them in cardboard tubes that are made in two longitudinal sections of which one half can be removed to display the rolled-up rug in the store offering it for sale. Each end of the tubular container is reinforced with a liner ring of slightly smaller diameter, some of which are on the arm of the woman pictured. The tooth-like projections on the disk which she is holding in her left hand are bent down over the outside surface of the liner ring and the assembly placed in the tube. The machine that performs these operations is shown here. The force by which the tube is pushed to insert the end assembly is exerted by the plunger at the left, which is actuated by compressed air. After the ends are in position they are sewed to form a permanent bond.